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We are indebted to a friend for the following clear and satisfactory explanation of the recent rupture of the boiler of the steamer Mohegan. It will be seen that the fault was not in the form, but in the construction of the boiler. Such accidents serve as useful lessons to the careful mechanic—by teaching the necessity of increasing the strength of the boiler in those portions which have hitherto been left comparatively weak.

EXPLOSION OF THE BOILER OF THE STEAMBOAT MOHEGAN.—APRIL, 1843.

The steamboat Mohegan, at the time of this explosion, was furnished with two copper multiflue or tubular boilers, two and a half years old, constructed after the plan of locomotive engine boilers, for railroads. The tubes, (260, or thereabouts, in number,) had a length of about eleven feet, with a diameter of about two and a half inches. One only, of the boilers burst. The rupture was in the flank of the outer cylinder or shell, partially underneath and nearly midway of the length of the tubes. It evidently commenced at an arm-hole, three by seven inches, in the side of the boiler. From this arm-hole a rent was made each way to the nearest seam or row of rivets, the portion separated hanging like a flap, of the width of a single sheet of copper, and forming an opening for the escape of hot water and steam, of about three square feet. The explosion was accompanied by a loud report, and the end of the boiler nearest the rupture, was raised some three feet from its bed. The circumstances attending this explosion do not appear to warrant the conclusion of its having been produced either by a deficiency in the supply of water, or from an undue pressure of the steam. The part which gave way, was low down in the boiler, and was not exposed either to the direct or indirect action of the heat, and could not therefore have been weakened from this cause, and had there been an extraordinary pressure of steam, the boiler, if properly constructed, would have yielded internally, as in all similar cases of locomotive boilers, by the rupture of one or more of the tubes, and the effect would also most likely have extended to the boiler, between which and the ruptured one there was a free communication.

The cause, therefore, for the bursting of the boiler was in all probability,

the want of a due degree of strength in the boiler itself, at the place of rupture. It is possible that this defect may have been in the copper. The sheet which gave way might have contained, perhaps, some flaw not discovered by the manufacturer. Supposing the material to be sound in all respects, still there were, in our view, mechanical defects in the structure of the boiler itself.

1st. The edge of the arm-hole was not protected from rupture by a band soldered and riveted thereto.

2d. The boiler rivets were too large, or too near together, by which, too much of the metal or substance of the copper was cut away.

3d. There were no stay-bars or bolts to support the sides or shell of the boiler, and no bands enclosing it.

This last circumstance is, we think, very conclusive as to the want of the requisite strength in the boiler. For the distance of eleven feet, the length of the tubes, no stay-bolts were inserted. The diameter of the shell of the boiler of this portion, is about eight feet. Its form cylindrical. With so great a diameter and length, the effect of the pressure of the steam acting with all the advantage of the funicular power in forcing out the sides of the boiler, it was scarcely possible that the copper should long be able to stand.

The locomotive boilers used upon railways are unquestionably the safest form of boilers, and for the very good reason that the shell is so much stronger than the tubes, that the latter under an undue pressure are always the first to yield, and as they are of small size the rupture of one or more is not attended with serious consequences. Each tube becomes in fact, a safety valve and the steam finds vent in a mode not likely to produce serious injury. The boiler of the Mohegan had less relative strength than a locomotive boiler, inasmuch as it was constructed of copper instead of iron, and of much greater magnitude. It is true that the former was designed to be worked with a less pressure of steam, but the difference in this respect was less than the difference in the absolute strength of the two descriptions of boilers.

A most important consideration in the construction of the tubular or multitubular boiler, is the giving to the exterior cylinder or shell a greater degree of strength than is possessed by the tubes. There is no difficulty in accomplishing this, even with boilers as large as those of the Mohegan. When so constructed, they are the safest form of boiler, and as they are not surpassed for effectiveness in generating steam, we hope that the case of the Mohegan will not be quoted to their prejudice, but serve rather to induce a more full investigation and thorough appreciation of their merits.

FULTON.

REPAIRS OF RAILWAYS.

All the first attempts at railways in the United States, as their defects of construction were developed in working them, were over and above that expense, put to heavy annual expenditures in correcting those defects, which

belonging more properly to construction, should have been charged to the capital in the road; but the whole appearing in *one item* under the head of ordinary repairs, has led to very exaggerated impressions as to the costliness of merely maintaining a railway, and which are yet indiscriminately entertained of the old and more modern structures, without considering that in the latter most of those original defects have been corrected, and that principally by a more liberal outlay in their first construction.

A case particularly illustrating this fact, is found in the Baltimore and Ohio railroad, among the earliest of these enterprizes, which after contending for several years with every difficulty, was nigh being abandoned in despair, and was only saved by Mr. M'Lane being called to preside over it in 1837, at which period he describes its condition in the following terms.

"The main stem to Harper's Ferry was in a state of utter delapidation, the moving power and machinery inadequate to the accommodation of the business actually offered for transportation. The department of repairs of the road was both expensive and inadequate, consisting of an unnecessary amount of superintendence without the requisite skill, and under large outlays, the road was annually becoming worse. All the repairs of machinery were made by others, under contracts at high prices, and so inadequately performed, that every part of the machinery was daily becoming more unfit for use. Public confidence appeared to be entirely withdrawn."

It is from its operations under this condition of things that most of the arguments have been drawn, and are to this day appealed to against the railway system in general. The report shows that from 1837 to 1842 the average annual expenditure in remodelling the road, was for those five years, \$83,400, or \$850 per mile, being \$370 for labor, and \$480 per mile for materials; and that now, although laboring under many miles of flat bar road, the expense for labor of adjustment and repairs of road, is reduced to \$650 per mile per annum. Instead, therefore, of the above dark picture of 1837, we have now its condition in 1842, described by Mr. M'Lane in the following bright colors; and considering the disadvantages still, of this machine, in *heavy grades, short curves and flat rail*, its present success may be appealed to, as the *complete triumph* of the modern railway system in judicious hands and in suitable locations.

"Here is now a system of railroad operations reduced to a scale of greater cheapness and economy than any other known to us in Europe or the United States, and brought to its present perfection by nearly five years of arduous toil and the exercise of all the skill and science the company could employ. It is daily complying with all the demands of trade, and giving universal satisfaction to the public, with fewer interruptions, and at less cost of transportation, than any other known road."

The reports from several roads for a series of years, furnish the following rates per mile per annum, for adjustment and repair of road, but as no details are given, it is not known what proportion belongs to repairs and what to re-construction, and the average being struck on merely the distance be-

tween the two termini of the road, without counting the miles of sidings or double track, they cannot be fully relied upon as showing the *true amount of ordinary cost of maintenance of road.*

Boston and Lowell,	26 miles,	edge rail,	average pr. mile for 5 years,	\$681
Boston & Providence,	41 "	"	"	5 " 367
Boston and Worcester,	45 "	"	"	5 " 501
Utica and Schenectady,	78 "	flat bar,	"	5 " 450
Georgia railroad,	100 "	"	"	5 " 240
Baltimore and Philad.	95 "	mixed rail,	"	3 " 500
Philad. and Reading,	56 "	edge rail,	"	2 " 300

The varying circumstances of the above roads, as to character of structure, soil, facility of drainage, prices of labor and materials, renders an average of them entirely futile, and shows the necessity of judging each road separately by its own merits and peculiarities.

To come, then, more strictly to the item of repairs and labor of adjusting track, let us look into the different constructions of road and show what is the whole cost of materials composing them; the entire consumption of these, *in a given time*, being of course the limit of the cost of these repairs, which fluctuating as to amount in the annual intervals, will result in the following average per mile for the whole period.

No. 1.

Ground sills 21,100 feet N. Car. pine per mile,	274	
Joint pieces 5,000 feet do.	66	
Sleepers 1,760 7 by 8 inch,	493-532	last 5 years, loss per mile per annum, 166
Bridges, wooden portion, average cost per mile,	1,500 " 12 "	" 125
Iron rail, chairs and spikes,	4,000 " 25 "	wear 25 per cent per ann., { 40 or per mile, }
		331
Labor of adjusting track and making repairs, per mile,		269-\$600

No. 2.

Ground sills,	per mile,	253	
Cross ties and joint pieces,		271	
Longitudinal string pieces, yellow pine,	316-840	last 5 years, loss per mile per annum,	140
Bridges, wooden portion, average cost per mile,	2,500 " 12 "	"	208
Iron rail, chairs and spikes,	4,000 " 25 "	wear 25 per cent per ann., { 40 or per mile, }	398
Labor of adjusting track and making repairs per mile,			312-\$700

No. 3.

Oak sleepers on broken stone ceds 1,700 pr. m.,	510	last 7 years., loss pr. mile. pr. an.	73
Bridges, wooden portion, average per mile,	2,500-3,010	12 "	208
Iron rail, chairs and spikes,	4,000	25 " wear 25 per cent per ann., { 40 or per mile, }	321
Labor of adjusting track and making repairs, per mile,			259-\$500

In the above, we have the true principle by which to estimate the labor and repairs of a railway, the amount of which, will be governed, and vary according to the location and other peculiarities of each road.

The periods assigned above, as the duration of each item are about the averages determined by past experience. The nature and seasoned character of the woodwork, but more particularly the variableness of soil to be expected on a long line, all more or less affect its durability. In certain soils

the oak timber will be destroyed in 4 to 5 years, and in others, last 10 to 12 years, the average about 7 years. Pine wood on the ground decays in 5 to 6 years. Locust and cedar the most durable, are too costly to be commonly used. The *frame timbers* of the bridges first well seasoned and then painted, should last 20 years, the flooring being the portion most exposed to decay, and an average of 12 years duration for the whole, is not an over estimate. The *rolled iron rail* it is now well ascertained, after 15 years experience, when of *originally good mineral and well manufactured* that its renewal costs little more than the labor of replacement, at which rate its entire cost could not be expended under 25 to 30 years, and where with two tracks, it is used only in one direction, it may be said to be everlasting, under almost any amount of business.

The exemption from bridges on a railway is a great saving, first and last, but is rarely found at less than the amount in our estimate. The long Island railroad is, however, *peculiar*, in being without a single bridge, and on a straight line, for 100 miles. The amount of business on a railway will affect only in a small degree the expenditures for adjustment and repairs, the nature of this machine being, on the score of safety in particular, to exact as good order for a small, as for a large business, and once in order, it answers with but a trifling addition of expense as well for the passage over it of a dozen as of only one daily train; hence is its full economy only found under a large business, and the fact made more manifest, that it is the cheapest means of transport, in all cases, for passengers and light freight; and under favorable circumstances for all kinds of heavy freight, carried at a speed of about 10 miles per hour.

Thus has the railway structure been gradually and *imperceptibly* acquiring strength and completeness in all its parts; and in none more than in its main spring, the locomotive, which is now made with a *vast increase* of power and efficiency, and with scarcely and more pressure on any single point of the road, than the cars it drags; so that as compared with its condition 10 years back, the *entire railway machine* is improved *one hundred fold*; and although the old data has thus been rendered obsolete, it is still commonly adduced against the railway system by the interested and uninformed, either entirely to condemn, or at least to show it up unfavorably in the comparison with canals.

The following cost of working English railways is taken from Professor Vignoles' lectures, and is useful as showing that our American railways are worked quite as economically.

	Per mile per train.	Lowest rate, cents.	Medium rate, cents.
Locomotive power, - - - - -	"	25	32
Repairs of carriages, - - - - -	"	8	8
Maintenance and repairs of road, - - - - -	"	14	16
Conducting traffic and stations, - - - - -	"	10	10
Rates, taxes, and government duty on passenger, - - - - -	"	14	16
Police, - - - - -	"	3	4
Management, - - - - -	"	5	6
Miscellaneous expenses, - - - - -	"	3	4
		80	80

This cost includes every thing save interest on loans and dividend on capital.

MAIN LINES OF RAILWAY FOR 1842.

The general impression is, that all our railways are actually sinking money, but this is not true of the principal main lines in various sections of our country, and still less so of many of the minor ones, which on the contrary are very profitable. The reports of the main lines for 1842, show an average yield of 5 per cent. on their entire cost in capital and loans, which for a period of such unparalleled stagnation, is doing very well; and as to their *indirect dividends* or saving to the public, (of which, however, it takes no note,) in transportation of person, merchandize and intelligence, it cannot be counted. Let us enumerate a few examples in round numbers.

Name of road.	Miles.	Cost.	Nett rec'd '42.	Pr. ct.
1 Philadelphia and Columbia, edge rail,	82	\$5,000,000	\$200,000	4
2 Philadelphia and New York, do.	87	7,000,000	400,000	5½
3 Boston and Albany, (first year) do.	200	9,600,000	385,000	4
4 Phila. and Baltimore, mixed rail,	94	6,000,000	230,000	4
5 Balt. and Ohio, to H. Ferry, do.	100	5,000,000	210,000	4½
6 Albany to Buffalo, flat rail,	322	7,000,000	640,000	9
7 Augusta to Madison, Ga., do.	147	2,400,000	135,000	5½
		1032	\$42,000,000	\$2,200,000

In the above costs, are included all the extraneous burthens with which many of these roads are saddled, and against which nothing could sustain them but an extraordinary elasticity peculiar to this improvement, for which it has generally no credit. In the instances where the stock has been temporarily annihilated, as with the *Baltimore and Philadelphia*, by the necessity of the immediate return of the loans, the railway, as a fair money making concern in proper locations, should not be held responsible. These drawbacks are not the fault of the system but its misfortune, and will serve as warning beacons in all future projects of this kind.

ANNUAL REPORT OF THE COMMISSIONERS OF THE CANAL FUND, FOR 1842.

We have seldom seen so much useful information condensed into a small compass, as we find in this document. Unlike most productions of the kind, it is clearly and methodically arranged, giving the result of great research in such a comprehensive form, that every reader may verify for himself the important conclusions drawn by the commissioners. Where all is so concise it would be useless to endeavor to form an abstract; we shall therefore content ourselves with giving such of the tables and statements as are of most general interest.

"The amount of toll received on each canal during the season of navigation in 1842, is as follows:

Erie canal,	\$1,568,946 56
Champlain canal,	95,957 54
Oswego "	31,222 19
Cayuga and Seneca canal,	16,948 16
Chemung canal,	7,702 05
Crooked lake canal,	989 39
Chenango "	13,615 38
Genesee Valley "	13,204 11
Oneida lake "	462 63
Seneca river towing path,	149 51
	<u>\$1,749,197 52</u>

"There is a diminution in the tolls compared with the year 1841 of \$285,685. Of this diminution, \$130,921, or 45 83-100 per cent, is on descending, and 154,754, or 54 17-100 per cent is on ascending freight.

The total tons of all descriptions of property which moved on the canals is shown to be \$1,236,931, and the total value of the same property \$60,016,608."

The most valuable part of this report is to be found in a series of comparative tables from which we shall make several extracts :

The total tonnage of all the property transported on the canals, ascending and descending, its value, and the amount of the tolls collected for the six years preceding, is as follows, viz :

Year.	Tons.	Value.	Tolls.
1838,	1,310,807	\$67,634,343	\$1,614,342 46
1837,	1,171,296	55,809,288	1,292,623 38
1838,	1,333,011	65,746,559	1,590,911 07
1839,	1,435,713	73,399,764	1,616,382 02
1840,	1,416,046	66,303,892	1,775,747 57
1841,	1,521,661	92,202,929	2,034,882 82
1842,	1,236,931	60,016,608	1,749,196 00

The total tons coming to tide water, for each of the last nine years, and the aggregate value thereof in market, were as follows, viz :

Year.	Tons.	Value.
1834,	553,596	\$13,405,022 00
1835,	753,191	20,525,446 00
1836,	696,347	26,932,470 00
1837,	611,781	21,822,354 00
1838,	640,481	23,038,510 00
1839,	602,128	20,163,199 00
1840,	669,012	23,213,573 00
1841,	774,334	27,225,322 00
1842,	666,626	22,751,013 00

The quantity of wheat and flour that came to the Hudson river rapidly rose to a maximum in 1840, since which year there has been a decrease.

The tonnage from tide water in 1842 was 123,294, the larger portion of which was merchandize.

"There is a decrease of merchandize going up the canals of 36,628 tons, and a decrease in the quantity of other articles of 793 tons, making a total decrease in the ascending tons, comparing 1841 with 1842, of 39,421 tons.

The tons coming to tide water have decreased 107,708, comparing the present with the preceding year."

Of the merchandize cleared at Albany, West Troy, and Schenectady, (94,212 tons)—about 60 per cent was left at the Erie canal, 11 per cent on the Champlain canal, 10 per cent on the Oswego canal, 7 per cent on the Cayuga and Seneca canal, and the rest on the other canals, from 1 to 3 per cent each.

WESTERN TRADE.

The products of other States coming by way of Buffalo, have rapidly increased in amount—being in 1842, 179,437 tons, nearly the same as for

1841—of these the agricultural products and miscellaneous articles have constantly increased, while the products of the forest and manufactures have slightly decreased since 1841.

The same proportion holds in regard to the tonnage from other States by way of Oswego—the amount however being but 9,217 for the last year.

STATE OF TONNAGE AND BUSINESS OF THE CANALS.

“The tonnage of the canals, whether in boats or rafts, having reference to its source, naturally falls under the following five general heads of classification:

1st. The products of the forest; 2d. Agriculture; 3d. Manufactures; 4th. Merchandize; 5th. Other articles.

It is in reference to this division of the commerce of the canals, that the following statements have been made out.

The commissioners have thought it not without interest to institute a comparison for a series of years of the tons, value and tolls of each head of transportation above given, in view of ascertaining the increase or diminution of the tons, value or tolls of the total movement. To this end, sundry statements have been compiled from the reports, corresponding to this, which have annually been made to the legislature for a series of years.”

The tons classified as above of the *total movement* on all the canals from 1836 to 1842, is as follows:

Year.	Products of the forest.	Agriculture.	Manufactures.	Merchandize.	Other articles.	Total.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
1836,	755,252	225,747	86,810	127,895	113,103	1,310,807
1837,	618,741	208,043	81,735	94,777	168,000	1,171,296
1838,	665,089	255,227	101,526	124,290	186,879	1,333,011
1839,	667,581	266,052	111,968	132,286	257,826	1,435,713
1840,	587,647	393,780	100,367	112,021	222,231	1,416,046
1841,	645,548	391,905	127,896	141,054	215,258	1,521,661
1842,	504,597	401,276	98,968	101,446	130,644	1,236,931
Total 7 years,	4,444,455	2,142,030	711,270	833,769	1,293,941	9,425,465
Yearly av. 7 ys.	634,922	306,004	101,610	119,109	184,848	1,346,495
Pr.ct each class,	47.15	22.72	7.55	8.85	13.73	100
An. av. 1836 to 1839, 4 years,	676,666	238,767	96,010	119,812	181,452	1,312,707
An. av. 1840 to 1842, 3 years,	597,264	395,654	109,077	118,174	189,377	1,391,546

Under the head of other articles are found chiefly stone, lime and clay—the larger part of which were for the constructions on the canal, as the decrease during the past year will indicate—beside these, gypsum and coal make up nearly the whole amount. The quantity of coal appears to be steadily increasing. From this table it will be seen that the annual average of the *total movement* obtained by comparing the last three with the preceding three years, increases two per cent per annum. This increase is the result of the increase of Agriculture, Manufactures and Sundries, over the decrease of the products of the Forest and Merchandize.

The tolls paid on the “total movement” of articles, and upon boats and

passengers, annually from 1837 to 1842, both years inclusive, are as follows:

Year.	Boats and passengers.	Products of the forest.	Agriculture.	Manufactures.	Merchandise.	Other articles.	Total.
	Dollars.	Dollars.	Dollars.	Dollars.	Dollars.	Dollars.	Dollars.
1837,	195,506	211,118	370,041	75,507	380,826	56,430	1,289,430
1838,	210,457	229,998	468,495	74,941	520,911	78,555	1,589,357
1839,	181,323	253,710	479,534	81,251	535,486	83,662	1,614,966
1840,	185,922	197,904	906,623	75,765	427,966	80,467	1,775,747
1841,	179,819	313,444	785,943	95,595	558,003	102,078	2,034,892
1842,	165,515	211,979	805,376	70,611	393,875	101,840	1,749,196
Total for 6 years,	1,117,644	1,418,513	3,718,012	473,670	2,823,067	503,032	10,063,578
Yearly average,	186,274	236,359	619,669	78,945	470,511	83,838	1,675,506
Per cent.,	11.12	14.11	36.96	4.71	28.08	5.00	100
Average from 1837 to 1839 both inclusive,	195,763	231,609	439,356	77,233	481,074	72,882	1,497,917
Average from 1840 to 1842 both inclusive,	176,785	241,109	799,981	80,657	459,948	94,795	1,853,275

Comparing the tolls for the same two periods of three years each—it will be found that the decrease is only on boats, passengers, and merchandize.

“ Thus it appears that, comparing the last three with the previous three years, while the average annual increase of the tolls is 7 per cent, the average annual increase of the total movement of tonnage, or of the matter which fills up the canals, is only 2 per cent. The reason for this is found in the fact that the forest, which for the last seven years has furnished 47 per cent of the tonnage, has contributed about 14 per cent of the tolls, and that agriculture, which has furnished but about 22 per cent of the tonnage, contributes now nearly 50 per cent of the tolls, and that while the tonnage of the

forest decreases 2, that of agriculture increases 3. The reason for the small increase in the *tolls* on the products of the forest, while there is a decrease in the *tons*, may be that a less number of tons was transported a greater number of miles, the natural consequence of a supply which must continue in every locality to be in an inverse ratio to the demand. The diminution of about \$20,000 in the tolls on "boats and passengers," is mainly, if not wholly on passengers alone, the toll on the passengers having been reduced in 1841 from two mills per mile to one mill per mile on each person carried on board of packet or freight boats."

From a table giving the tonnage of each class of articles coming to the Hudson river, the following information is derived.

"Of this tonnage, the forest furnishes about 60 and agriculture about $31\frac{1}{2}$ per cent., in all about $91\frac{1}{2}$ per cent; that the forest decreases and agriculture increases in nearly the same proportion, keeping the tonnage just about stationary, the annual average of the last four years, being 675,449 tons, and the annual average of the last eight years being but 676,736 tons."

The course of the tonnage between Utica and Albany is shown by the lockages at Alexander's lock—the first west of Schenectady. The increase of the annual average of these for the four last over the four preceding years is 1,519, equal to a gain of 1 53-100 per cent. per annum.

Estimating the business of this, the main thoroughfare of the Erie canal, by the boats clearing from and arriving at Albany and Troy, it is found that the annual average for the last five years is 956 less than for the five preceding, being a decrease of 59-100 of one per cent per annum for the last five years. Notwithstanding this decrease it is stated that a large portion of the lockages in 1829, 1840, 1841, were consequent upon the enlargement of the canal, being for stone and other materials for the works between Utica and Schenectady.

"One ton of the products of agriculture pay more than four times as much toll as one ton of the products of the forest. The tons of the products of the forest which came to tide water in 1842, were 321,480, or about one-half the tonnage which came to tide water. If hereafter none of the products of the forest should reach tide water, and its place should be supplied by only 80,000 tons of the products of agriculture, the canal might lose nothing in tolls, and would get rid of 240,000 tons, or more than one-third of the tonnage arriving at tide water. Thus it will be seen that the tonnage may very sensibly diminish and the tolls may, at the same time, and at the present rates, increase."

From the internal demand of the State for bread stuffs, it is estimated that the surplus arriving at tide water, of the *growth of this State*, will little if any exceed that of past years.

"Thus it is comparing 1836 with 1842, that while the increased delivery at tide water of flour and wheat, is about 75,000 tons, the increase from western States is about 100,000 tons. It will be seen also that the products of this State, and the delivery at tide water in 1840, exceed that of either of the two subsequent years, while the product of western States steadily increases."

The results of a table of lockages at seven different points, confirm the evidence before given.

"At every point west of Utica, the lockages seem to have been less in the last year, than in 1835 or 1836.

It is seen that at Alexander's lock, three miles west of Schenectady, the lockages in 1841 were over 30,000 with a single lock, while at Black Rock and at Lockport, they were less than 12,000 last year, and at the Syracuse lock, (east of Syracuse, and taking the tonnage from the Oswego canal.) 19,397, and at each place less than in 1836.

Similar results are shown on the Champlain canal, in the years 1835, 1836, 1837 and 1838, since which latter year the lockages have not been obtained."

The number of miles run upon the canals by all the boats is ascertained exactly by the boat tolls. The miles run by freight boats were greatest in 1838 and 1841—those run by packet boats decreased from 1837 to 1840, and have since increased. The annual average of the whole for the last three years, has increased 530,097 or 276-100 per cent per annum."

The conclusion we give in the words of the document as being too important to admit of curtailment.

"The foregoing detailed evidences of the trade and tonnage of the canals, are the results of a system of statistical returns by the collectors of tolls, put in operation in 1836, and continued to the present time. A recapitulation of the results to which a careful examination of these evidences has led, are as follows:

1. *Total movements, in tons, on all the canals.*

Comparing the last three with the previous four years, the increase is 2 13-100 per cent per annum.

2. *Total movement of boats, in miles, on all the canals.*

Comparing the past three years with the previous three, the increase is 2 76-100 per cent per annum.

3. *Tons arriving at tide water.*

Comparing the last four with the previous four years, the increase is 11-100 of one per cent per annum.

4. *Boats arriving at tide water.*

Comparing the past five with the previous five years, there is a decrease of 59-100 of one per cent per annum.

5. *Lockages at the lock three miles west of Schenectady, called Alexander's lock.*

Comparing the last four with the previous four years, the increase is 1 53-100 per cent per annum.

6. *Tons of merchandize ascending the canals.*

Comparing the last four with the previous four years, the increase is 1 42-100 per cent per annum.

These, it will be observed, are six separate and distinct tests of the condition of the trade and tonnage of the canal in the last three, four and five years, as compared in each case with the previous three, four and five years.

Tests numbers 1 and 2, relate to the *total movement* of all matter on all the canals to and fro, whether coming to tide water or not, both showing an increase of over two, and less than three per cent per annum.

Tests 3, 4, 5, and 6 relate only to the property arriving at and going from tide water, showing an increase in the tons of arrival, of only 11-100

of one per cent per annum, and a *decrease* in the arrival of boats of 59-100 per cent per annum.

The lockages at Alexander's lock, as has been before observed, were doubtless increased in 1839, '40 and '41, by the temporary transportation of stone for the enlarged locks.

But while there has been less than 3 per cent average annual increase in the *total movement* on the canals in the last three years, and only 11-100 of one per cent increase in tons, arriving at tide water, there has, in the same time been an average annual increase of over 7 per cent per annum in the tolls received on all the canals.

The increase of over two per cent in the total movement on all the canals, is not only reconcilable with the stationary condition of the tonnage arriving at the Hudson, but is in perfect harmony with it. The increase of population in the interior, while it contributes to the internal trade of the canals, by an exchange of commodities between different sections of the country, at the same time creates a demand for those bulky products of the forest, and those products of agriculture, which, at an earlier period and with a sparser population, are sent to the sea board.

The relative proportions which the tons of the different classes of articles arriving at tide water in the last eight years bear to each other, are as follows:

	Per cent.
Products of the forest,	60 39
Agriculture,	31 54
Manufactures,	1 69
Merchandise,	00
Other articles,	6 29
Total,	100 00

It has been shown that the increase in tons of agriculture arriving at tide water just about keeps pace with the decrease, in tons, of the forest, and that as those two sources furnish about 92 per cent of the tonnage, the average delivery at tide water for the last four years has been about stationary.

It has also been shown that the increased delivery at tide water of wheat and flour is but just about equal to the increase of those staples from the western States by the way of Buffalo and Oswego, thus showing that the surplus production of our own State is stationary.

The commissioners are not prepared to say that the results of the last four or five years, as compared with an equal number of previous years, are to be taken as a sure indication of the future. The evidences of the comparative condition of the trade and tonnage of the canals are given as they find them in an authentic shape. They are the only *facts* on record—the *only basis* of an estimate for the future. Resting upon the results and assuming as it is safe to do, until the results of other years are obtained, that they are correct indices of the future, the commissioners are led to the following conclusions:

1. That owing to the diminution of the forest, the tonnage arriving at tide water, over the most crowded portion of the canal, has nearly if not quite reached its maximum.

2. That owing to the decrease of the forest and to the practice of carrying larger cargoes than formerly, the arrival of boats at the Hudson river, which has *decreased* one half of one per cent per annum in the last five years, is not for a long time to exceed the average of those years, which have been accommodated by a single lock.

3. That as 30,000 lockages can be made in a season of navigation by a

single lock, as has been tested at Alexander's lock, through which the tonnage arriving at tide water on the Erie canal passes—as the largest lockage at any one lock west of Utica, is at the Syracuse lock, which has been as follows.

In 1835,	-	-	-	-	-	-	22,258
1836,	-	-	-	-	-	-	21,692
1837,	-	-	-	-	-	-	18,181
1838,	-	-	-	-	-	-	20,383
1842,	-	-	-	-	-	-	19,397

As the lockages at the Lockport locks have been as follows:

In 1835,	-	-	-	-	-	-	10,925
1836,	-	-	-	-	-	-	13,808
1837,	-	-	-	-	-	-	10,041
1842,	-	-	-	-	-	-	11,697

There is reason to suppose that the internal trade of the canals will never task the capacity of single locks.

4. That owing to a change in the character of the tonnage, from the products of the forest to the products of agriculture, which, without increasing the arrival of tons at tide water, has in the last four years, added an average of \$355,000 to the tolls; there may, for the same reason, be a further average addition to the tolls, without any increase of tonnage.

The information thus accumulated is of the utmost value to this State—showing as it does, that while the demands upon the capacity of the canal are on the decrease, the revenue to the State is on the increase. Could the knowledge of these facts have been anticipated a few years since, we may safely say that millions would have been saved. It is not yet too late to profit by it—and we only hope that a continuance of the research manifested in this paper, may in future years be made available for the public benefit.

MR. VIGNOLES' LECTURES ON CIVIL ENGINEERING, AT THE LONDON UNIVERSITY COLLEGE.—SECOND COURSE.—LECTURE XVII, AND LAST.

Before proceeding to a summary of the second course, Mr. Vignoles observed, that there was a material point connected with the subject which had not been sufficiently discussed—viz. the motive power to be employed; on this greatly depended the principles on which a line of railway should be laid out, the end and object being to convey the greatest extent of traffic at the least cost; this cost was compounded—first, of the interest of the capital expended, which should be considered a constant charge; and second, of the periodical working expenses—the work to be done being summed up in the general expression of “overcoming all obstacles to facility of motion.” What are these obstacles? They might be divided into two great heads—Gravity and Friction. 1st. Gravity is a natural cause existing under all circumstances, and affecting lines deviating from the horizontal, in direct proportion to the sine of the angle of inclination. Engineers, therefore, have considered that the first principle in laying out roads, should be (under limits) to approximate as nearly as possible to the horizontal, in order to exclude one of the great causes of obstacle; since, with maximum loads, the retardation arising from gravity is most felt. When such could not be effected, then to distribute the total rise (or effect of gravity) along the easiest ratio of slope. But, in practice, the occurrence of maximum loads, in ordinary passengers and merchandize traffic, forms the exception, instead of constituting the rule; and it is only when a regular and constant heavy trade is

to be anticipated that horizontal communications should be insisted on. 2nd. Friction is a physical cause, varying according to the perfection of the road and of the vehicles moving on it. In the practical working of a railway, however, so many expenses arise under the heads of "conducting traffic, management, etc." common to most lines, whatever the gradient, that they tend to make the cost of overcoming friction and even gravity (particularly with the ordinary light loads) but a small fraction of the total charges. Comparing the amount of obstacles on a railway with that on the ordinary road (where the friction, meaning thereby axle-tree friction and surface resistance, may be called sixteen to twenty times greater than on a railway.) and assuming the inclination on railway and road to be the same, the general result is that the perfection of the railway surface moved over, and the improvement of carriages, or rather that of their wheels and axles, cause the effect of gravity to be felt in the most sensible degree on railways; while the imperfection of the road causes it to be comparatively scarcely appreciated. Hence with the wretched surfaces of the old roads, and the clumsy wheels of our primitive vehicles, the hills seems to have scarcely added to the obstacles to be overcome. As the road surfaces and carriages improved, and increased speed and heavier loads were introduced, the necessity for the greater perfection of the ordinary road became apparent, and the remedy was applied in various degrees during the last 100 years until it was completed as far as possible, in the extensive improvements by Telford and Macneill on our great highways. But in carrying out this principle on railways we have run into the opposite extreme. We should first take in one sum the retarding causes of gravity and friction—viz: the friction, being constant, or nearly so, putting aside the resistance of the air at high velocities, varying only in the perfection of the wheel axles, and in the mode of lubricating, (the surface resistance on railways being, practically speaking, nothing,) and the maximum gradient, or rather the gravity due to it:—their sum will be the constant divisor for the motive-power, of whatever description that motive-power might be; and, in considering the latter point, it must be the distribution of the traffic, or what may be called the average hourly load throughout the year which is to determine the question. In many instances, in this point of view, it would probably often be found most economical to use animal power, (as is done on the Edinburgh and Dalkeith railway,) were not velocity required—which, on railways, enters so materially into the calculation, that mechanical power in some shape becomes necessary; and this divides itself into stationary power, or when too mechanical means are fixed, and locomotive power, or when the machine travels along with the load. There are two serious difficulties connected with the latter system; first, a great addition to the load, equivalent to the average of doubling it; and next, that the fulcrum through which the motive power must be transmitted—that is, the rail on which the locomotive driving wheel impinges—is greatly affected by atmospheric causes, occasioning great variation in the adhesion, and consequent uncertainty from slipping of the wheel, so that, as explained in a former lecture, the load after a locomotive engine is really limited by its adhesive power, and not, as first might be supposed, either by the cylinder power or boiler power. Considered abstractedly, stationary power is cheaper and always would be so if the traffic were certain and regular, with maximum loads and very moderate speed, even with the present obstacles of ropes, sheaves, and all their contingent complicated apparatus; but at high speed, with a great length of rope, the experience of the working of the Blackwall railway has shown that for passenger trains only, there was, compared with the most expensively worked lines on the locomotive system, to say the least,

no economy in the motive power, though other conveniencies arising from the peculiar arrangements on that line, were, perhaps, in this special case, more than equivalent. A most serious obstacle to stationary power, was the necessity of absolutely stopping, and disengaging and refixing, the trains at each station, which stations could not be conveniently, and certainly not economically, placed further apart than three to five miles, for it could readily be proved, that on a continued distance of six or seven miles of railway worked by a rope, the power of the largest engine that could well be erected, would be absorbed in moving the rope only. The Professor then went largely into a consideration of applying stationary engines as the motive power in working inclined planes under a variety of circumstances, and recommended to the students to consult the valuable work of Mr. Nicholas Wood on this subject, and indeed on all the details of railway working, of which, particularly in the third edition, there was most of the latest information. In many situations, however, where water power could be obtained, the stationary rope and pulley system might be advantageously introduced. Gravity became the motive power, on what were called self-acting inclined planes; that is, when the gravity of a descending train of laden carriages brought up a train of others empty or partially laden; or where skeleton wagons, or water tanks on wheels, could be useful as artificial counterbalancing weights in either direction alternately; the circumstances under which self-acting inclined planes could be properly introduced were rare. Mr. Vignoles then gave a clear account of various modes of working self-acting inclined planes; among these was described a curious and interesting one near the great limestone quarries in North Staffordshire; another on the St. Helen's and Runcorn Gap railway, which he had himself put up, and also the planes for the Great Portage railway, across the Allegheny Mountains, in the United States of America. Stationary power might also be used to a greater extent on the atmospheric system, whereby, to speak metaphorically, a rope of air was substituted for a rope of hemp or wire, and where no pullies were required, nor any necessary stoppage at the intermediate engines, where only the carriages had to be moved, and where nearly the whole dynamic force generated was made available for motive power. This system had already been explained to the class, and practically illustrated on a railway thus worked, and need not be further alluded to. The Professor was preparing for publication a separate lecture "On the Atmospheric Railway System," to be illustrated with plates, and tables, and appendices, in which that interesting subject would be fully gone into, and all the mathematical and philosophical investigations given, with estimates of the cost of such railways under various circumstances of traffic and gradient; fully enabling the value of the principle as a motive power, to be appreciated. Although modern practice had almost discarded the use of animal power from railways, it might be proper to refer cursorily to it. A horse seems adapted to drag vehicles, from the mode in which he adopts his muscular action, so as to throw the greatest effect on the line of draft; in making an effort to draw a carriage, the body of the animal is bent forward, throwing upon the latter the part of its weight necessary to overcome the resistance, the muscular force of the legs being employed in keeping up his traction and moving the body onward; the effort of the animal being revolvable into these two parts—viz. the action on the load, and that required to move itself by. It may be gathered from writers on this subject that the force a horse is capable of exerting, is that equal to about one-seventh or one-eighth part of his own weight: or that, on an ascent of one in seven or one in eight, the exertion required to overcome his own gravity, is a force equal to that he is able

to exert on a road on a level plane. Taking the average weight of a horse, and considering that he is capable of occasionally exerting great extra power on the load, still it seems to be satisfactorily ascertained, that nearly seven parts out of eight of the muscular power of a horse is required to drag his own weight forward, leaving, of course, only one part applicable to the load. But the criterion of a horse's power in practice is not the occasional effort of which the animal is capable at a dead pull, or for a short period: we must estimate his strength by what he can do daily, and day after day for a long period, and without breaking him down prematurely. If a horse is to travel at the rate of ten miles an hour his power of pulling is greatly diminished, and he can work only an hour or so in the day: at two miles an hour he may give out a power of 150 lb. on the load: at ten miles he has scarcely 35 lb. to spare, and at 12 miles an hour he can seldom be expected to do more than move himself. This was on the average of horses—all beyond were exceptions. Thus, the application of horses to railways as the motive-power was very limited: and in laying out lines where they are to be used, to full effect, gravity should be arranged to be always with the load, or, at least, not against it; the rate of travelling only 2 or 2½ miles per hour, and the traffic uniform. Mr. Vignoles proceeded to an interesting comparison between locomotive and stationary power up inclined planes, taking the inclination of 1 in 50 as a medium, and showed that *when the traffic was small and the loads consequently comparatively light, and the daily number of trains not great, locomotive engines, as the motive-power, (taking into consideration all circumstances of first cost, and working expenses—particularly the latter, of which the locomotive power was but a small part,) would not be so expensive as stationary engines, while they would be certainly more convenient; and that, with all the best modern improvements in the locomotive engines, the system of working with large cylinders, using the steam expansively on the level and falling parts of the railway, improved boilers, etc., planes of 1 in 50 might be practically worked; the only material drawback being, occasional slipping of the wheels on the ascent, and the necessity of great caution and careful application of the brakes on descents; but on the whole, the balance, under the above circumstances, was much in favor of the locomotive system.* The Professor then entered into a very long and minute comparison of the present system of working the Blackwall railway by stationary engines, with ropes and pulleys, with what would be the case if the motive power were locomotive engines—and by tables, showed that while the working of the Blackwall Railway (3¼ miles) on the stationary system, was costing about *seventy-two pence* per mile per train, the cost of working the Greenwich railway (3¼ miles) was only about *forty pence*:—but, Mr. Vignoles admitted, that by the former, great accommodation to the public was afforded by the numerous intermediate stations, while on the latter, there was only one stoppage. In concluding the general comparison between the two principles of mechanical motive-power, the Professor observed that on the locomotive system, a minimum of power need only be provided in the first instance and the number of engines might be increased gradually as the traffic required, which was a great consideration when the first expenditure of capital had to be kept down to the very lowest terms, at all future risks. On the stationary system, provision had been made from the outset, for the maximum anticipated trade, which of course increased the first outlay on the railway establishment, and depended on the ultimate economy of future working to make up the difference. Having concluded the notice of various descriptions of *motive-power* employed on railways, of which the preceding is but a mere

outline, some general remarks were made on the principles of laying out railways, in reference to the several systems respectively.

In a concluding general summary, Mr. Vignoles observed, that in his first course, at the latter end of 1841, he had fully considered the practical rules for earthwork and constructions:—these were not peculiar to railways; the theory and practice of bridge-building, applied to all internal communication, and would be most conveniently considered in a separate illustrated course, but he wished to recall to the class generally, that in proceeding to lay out railways in the first instance, the engineer ought to enter much more deliberately into these previous inquiries, so absolutely necessary, than had hitherto been done. A system of applying the same general rule of perfect gradients alike to lines, of the least as well as of the greatest traffic, had too much prevailed, and until more rational ideas were substituted, the public would shrink from embarking in enterprises subject to all the contingencies of extra cost beyond estimates which had characterised almost every railway in this country. *The earthwork and its consequences*, regulated the cost, particularly as regarded contingencies, and the utmost consideration should be bestowed as to how far it was justifiable to encounter the expense of these operations. The average cost of earthwork, and all consequent works of art, etc., on the English railways was nearly £15,000 per mile, or about 50 per cent of the whole capital expenditure. Mr. Vignoles was decidedly of opinion that in *all future lines in this country, and particularly on the continent*, the correspondent outlay ought not to exceed £5000 per mile, and that beyond that sum perfection of gradient would be bought too dearly. In reference to the *gauge* of railways, Mr. Vignoles stated distinctly, that theoretical investigations and practical results led him to consider a six foot gauge the best; but the present 4½ foot gauge was certainly rather cheaper. In respect of *curves*, he observed, that they were much less disadvantageous than had been first supposed: that a half mile radius is now everywhere admitted; and that he himself did not hesitate to adopt a quarter mile radius whenever expense could be materially saved; and if the atmospheric system of motive power should be found to succeed on a large scale, the curves might, on lines thus worked, be safely made still sharper. In regard to the systems of constructing the *upper works*, he had in a recent lecture, entered so fully into the comparison, that he need only now say, that if the expensive and complicated system of heavy rails and chairs, and cross sleepers, were preferred by engineers, then the ingenious improvements of Mr. May, of Ipswich, in chairs and fastenings, applied by Mr. Cubitt on the South Eastern (Dover) railway, with great care in laying, draining, and ballasting, made *that system* perfect and complete. The Professor, however, decidedly gave the preference to the less costly, and the more simple system of lighter rails, without chairs, laid on continuous longitudinal balks of timber of sufficient scantling and fastened on Evans's principle, modified in the manner shown by the models exhibited to the class; and several engineers were adopting this opinion. On the continent of Europe, where iron was dear, and timber cheap and abundant, Mr. Vignoles calculated a saving of full £2000 per mile of double road would accrue from the adoption of the latter system—which afforded a vast national economy. In reference to the subject of working drawings, plans, and sections, the Professor reminded the class of the importance he attached to having all such previously made out on a large scale, that the cubic quantities might be accurately obtained, and the just prices considered; and thus, in proceeding to make the estimates, nothing would be left to conjecture, and as little as possible left to be afterwards altered. The period of time for the execution

of the works should be extended as far as consistently could be done. The two great sources of the extra expenditure on railways had been, the extreme haste with which the work had been pushed on, and the changes of every kind from the original designs. These points being all carefully considered, *even before the plan was brought before the public in general*, the estimates might be better depended on. Mr. Vignoles then went through all the great items of expenditure generally arising on first construction, and explained how the accounts of measurements should be made out and kept under very distinct general heads, subdivided into minor items, from the purchase of the land to the last finish to the stations, and the entire fitting up and furnishing of the carrying establishments. Sufficient experience had been attained in all these matters to enable the engineer, in future, if the above rules were faithfully followed out, to place himself beyond all chances of reproach for making erroneous estimates. In conclusion, the Professor observed, that he had selected railways at the request of the class, as the theme for the course just concluded; but although so much consideration had been given to the subject, he had only been able to touch in a very general way upon the chief points; yet it was to be hoped a sufficient idea had been given of the principles of construction, and of their general application, to create an interest in their minds. Should any of the students hereafter be employed to execute a railway, he trusted they would recollect these lectures with advantage, while they would also probably better understand and appreciate them: at the same time, he must not neglect to impress upon them, that it was not at the college, in the lecture-room, or even in the office of an engineer, that all the duties and knowledge necessary could be taught: the young aspirant must pass much time in the work-shop, indeed, he must become a workman, and acquire the use and skill in the handling of tools, and the erection of mechanism of every kind—and passing to the actual works, ought to learn to be able to direct personally the labor of the mason, the carpenter, and the smith. "Above all," said Mr. Vignoles, "the student in engineering must carry into life with him the constant remembrance of what I have so repeatedly enforced, that the reputation of an engineer in this country is based upon the success of his works, of his mechanism, and of all the efforts of his mind and hand, in respect to, and in proportion to their being productive of commercial and beneficial results, to those who, at his suggestion, may undertake to provide the necessary funds: and he should consider how this result can be best obtained, rather than study the splendor of his undertakings. It is for the architect to attend to the decorative and the beautiful; it is sufficient for the engineer to study proportions, and rely on the simple grandeur of his works as a whole. It is related that Napoleon once observed to the celebrated Carnot, "*Les ingenieurs doivent toujours avoir des dees magnifiques*;" this is true as to their first conceptions, but in the realization, they must be sobered down by the rules of economy and judgment. After the first burst of talent, after image and form has been given by the hand to the bright idea emanating from the brain, let it be brought out to practical application only after a strict inquiry into the cost. Remember what I quoted on a former occasion, when contrasting the two celebrated light houses, the *Eddystone Cordouan*—no unfit emblem of the two celebrated engineers who erected them may I venture to add of their respective nations—remember, I say, "*'tis use alone that sanctifies expense*."

REPORT OF THE PATENT COMMISSIONER.

We give the Patent Office Report entire in this number—but the docu-

ment as presented to Congress contains a vast amount of information relative to the products of our country, and will furnish us with several themes upon which to discourse in future numbers.

PATENT OFFICE, January, 1843.

SIR: In compliance with the law of Congress, the Commissioner of Patents has the honor to submit his annual report.

Five hundred and seventeen patents have been issued during the year 1842, including *thirteen* re-issues, and *fifteen* additional improvements to former patents, of which classified and alphabetical lists are annexed, (marked B and C.)

During the same period three hundred and fifty-two patents have expired, as per list marked D.

The applications for patents during the year past amount to *seven hundred and sixty-one*, and the number of caveats filed was *two hundred and ninety-one*.

The receipts of the office for 1842 amount to \$35,790 96, from which \$8,068 95 may be repaid on applications withdrawn, as per statement E.

The ordinary expenses of the Patent Office for the past year, including payments for the library and for agricultural statistics, have been 23,154-48, leaving a nett balance of \$5,264 20, to be credited to the patent fund, as per statement marked F.

The above expenditures do not include those incurred within the last year for the recovery of the stolen jewels.

For the restoration of models, records and drawings, under the act of March 3, 1837, \$14,060 02 have been expended, as per statement G.

The whole number of patents issued by the United States, previous to January 1843, was *twelve thousand nine hundred and ninety-two*. The continuance of the depression of the money market, and the almost universal prostration of all business, operates very disadvantageously on the receipts of this office, as many hundred applications are delayed solely from the want of funds or difficulty of remittance. The patents granted for the year, however, exceed those of the year previous by *twenty*, though there have been less applications by *eighty-six*.

The Digest of Patents, continued and brought down to January, 1842, has been printed, and 700 copies distributed to the respective States, and 200 copies deposited in the library, in compliance with the resolution of Congress directing the same.

The accommodations granted during the last year for the reception of the articles received through the exploring expedition, intrusted to the National Institute, must seriously thwart, if not suspend, the design of Congress in the reorganization of the Patent Office, which enacts, section 20, act of July 4, 1836, "that it shall be the duty of the commissioner to cause to be classified and arranged in such rooms and galleries as may be provided for that purpose, in suitable cases, when necessary for their preservation, and in such a manner as shall be conducive to a beneficial and favorable display thereof, the models, and specimens of composition and fabrics, and other manufactures of work and art, patented or unpatented, which have been or shall hereafter be deposited in the said office.

While the annual receipts of the Patent Office above the expenditures are sufficient to carry out fully the benevolent object of the National Legislature, the want of room of which it is thus deprived will be, for a time, an insurmountable obstacle, as all the rooms in the gallery could be advantageously used either by the Patent Office or the National Institute. No

remedy, therefore, remains, but an extension of the building, which might be done by the erection of a wing sufficiently large to accommodate the Patent Office on the first story. The building can also afford room for lectures by professors, should they be appointed under the Smithsonian bequest; and may I be permitted here to observe, that a gratuitous course of lectures in the different branches of science would certainly do much to diffuse knowledge among men. I can confidently say that the agricultural-class look forward with bright anticipations to some benefit from the Smithsonian bequest, and to the time when the sons of agriculturists, after years of toil at the plough, can attend a course of lectures at the seat of government, and there learn, not only the forms of legislation, but acquire such a knowledge of chemistry and the arts as will enable them to analyze the different soils, and apply agricultural chemistry to the greatest effect. Such encouragement will, indeed, stimulate them to excel in their profession, while others, deemed by many more favorable, are indulged with a collegiate course of education. Little, indeed, has been done for husbandry by the General Government; and, since eighty per cent of the population are more or less engaged in this pursuit, the claim on this most beneficent bequest will not, it is hoped, be disregarded. The National Agricultural Society, in connection with the Institute, will most cheerfully aid Congress in carrying out their designs, for the great benefit of national industry.

It is a matter of sincere congratulation, that the Patent Office has so far recovered from its great loss in 1836, by the conflagration of the building, with all its contents. A continued correspondence with 11,000 patentees, and untiring efforts on the part of all concerned with this bureau, has accomplished much; indeed, to appearance, the models are better than previous to the fire. Although something remains yet to be done, enough has been accomplished to remove the past embarrassment, and afford applicants the means of examination as to the expediency of applying for a patent.

The loss to the library, sustained by the fire, is not yet fully repaired; and, since the law of 1836 makes it a duty to examine all applications for patents, with reference, also, to foreign inventions, it is absolutely necessary that the library should be extended.

It is true that the library of Congress possesses some books on scientific subjects, useful for reference in the labors of this bureau, but no permission is given to take out books from that library; and, if such liberty were granted, it would be bad economy to send an examiner to the capitol, to look up similar cases. If applications are to be examined, it will promote the despatch of public business, protect against spurious patents, and give public satisfaction, if the Patent Office library is well supplied with necessary books.

Already, hundreds of applicants are satisfied, by the comparatively imperfect examinations now made by referring to books on hand, not to take out a patent, and when, in the rejection of cases, reference is made to foreign patents, there is an impatient desire to see the description of the invention that is to cut off the hopes of so many years of toil and labor. I would therefore most earnestly recommend an appropriation of \$1,200, from the surplus fund, to add to the Patent Office Library.

The annual agricultural statistics comprising the tabular estimate of the crops for the past year, with accompanying remarks and appendix, will be found subjoined, (marked A.)

The value of this document to the whole country, from year to year, it is believed, would justify a much larger appropriation from the Patent Office fund for this purpose. The diffusion of such information may save

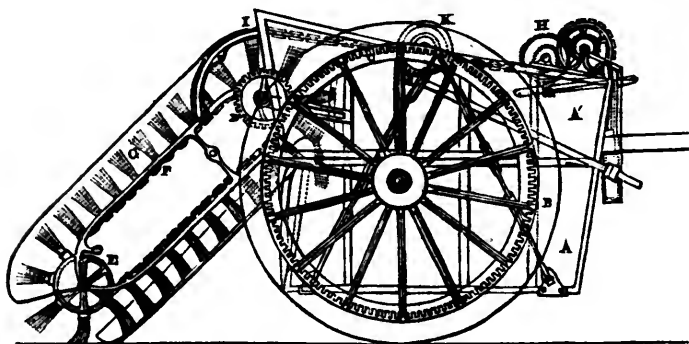
millions to the laborious tiller of the soil, besides adding directly to his means of export many millions more. An examination of this subject, and the expediency of fixing it on a more permanent and advantageous basis, by the constitution of an agricultural bureau, or at least an agricultural clerkship, at a moderate expense, to be drawn from the patent fund, is respectfully suggested. The additional benefit which must thus accrue to the population of our widely extended country would soon be seen.

A sufficient appropriation to allow a personal examination of the various parts of the country, by some one well qualified for such duty—similar to what has been attempted with so much success by some of the State legislatures—would, it is believed, realize a vast amount of practical good to the South and West, by furnishing the data on which they might direct their products to the best market, for domestic sale or foreign export.

Such, indeed, are the great benefits to result from personal observation and critical examination, not only of the crops, but agricultural implements—such the importance of explaining the new improvements, and collecting and distributing all the acclimated seeds, which are proved to be so signally productive or beneficial, that the Commissioner of Patents has doubted whether a modification of his duties, in connection with the Patent Office would not be more useful to the community. During the last year, he embraced the opportunity, while travelling to examine the crops in ten States; and though the examination was of course imperfect, it enabled him the better to digest the somewhat discordant materials from which the agricultural statistics here incorporated were compiled. If millions can be saved to the public, if the agriculturist can be encouraged in his all-important pursuits, by the expenditure of a small sum from the annual surplus of the patent fund, what better destination could be given to this amount? Would not the people heartily approve and earnestly second such an undertaking?

All which is respectfully submitted.

H. L. ELLSWORTH.



WHITWORTH'S PATENT SWEEPING MACHINE.

This machine, lately brought into operation in the town of Manchester, where it excited a considerable deal of public attention, has lately been introduced into the metropolis, and is now employed in cleaning Regent street. It is the invention of Mr. Whitworth, of the firm of Messrs. Whitworth & Co., of Manchester, engineers, by whom it has been patented. The principle of the invention consists in employing the rotary motion of locomotive

wheels, moved by horse or other power, to raise the loose soil from the surface of the ground and deposit it in a vehicle attached. The apparatus for this purpose is simple in its construction; it consists of a series of brooms (3 ft. wide) suspended from a light frame of wrought iron, hung behind a cart, the body of which is placed near the ground, for greater facility in loading. The draught is easy for two horses, and throughout the process of filling, scarcely a larger amount of force is required than would be necessary to draw the full cart an equal distance.

The following description of the machine by a reference to the accompanying engraving, will explain its action. The cart is constructed with plate iron, and consists of two parts, A, A; the lower part A is suspended to the upper part, and when filled is lowered and replaced with an empty one. To the off-side wheel B, is attached, on the inside, a cog-wheel, C, which works into a pinion, D, on the end of a shaft the length of the back part of the cart, and fixed thereon are two pulleys 1 ft. diameter and 2 ft. 4 in. apart: two other corresponding pulleys, E, are fixed upon a lower shaft, which is suspended to the upper shaft by a wrought iron frame, and over these pulleys pass two endless chains, F, to which the broom G, consisting of 29 rows, each 3 ft. 4 in. long, are attached. It will thus be seen, that when the large wheel of the cart is set in motion, it will, by means of the large spur wheel C, turn the pinion D, and with it the pulleys and the endless chain and brooms that pass over them: and as these brooms come in contact with the road, they sweep the mud up the inclined plane into the bottom part of the cart A. For the purpose of raising the brooms from off the ground, there is an apparatus H, consisting of an endless screw working into a level wheel upon a shaft which passes across the top of the cart: upon this shaft are fixed two pulleys, to which are attached two chains, which pass along the top of the cart and over the quadrants I, at the back, and there fixed to the iron frame of the apparatus,—so that when the endless screw is turned the chains are coiled round the pulleys, and raise the apparatus to any height it may be requisite. For the purpose of removing or emptying the lower portion of the cart, it must be raised to a horizontal position; as this apparatus is raised it throws itself out of gear by means of a lever attached to a clutch fixed on the end of the pinion shaft D. To the apparatus H, there is another motion attached for regulating the pressure of the brooms on the ground, according to the state of the weather and the nature of the surface, consisting of a series of weights in the box in front, suspended to two chains, which pass over pulleys on the axle of a wheel that works into another wheel on the same shaft as the first wheel described of the apparatus H.

There is also another apparatus K, for raising and lowering the lower part of the cart, consisting of an endless screw working into a cog-wheel, the shaft of which passes across the top of the cart, and on each end are pulleys, round which the chains are coiled that suspend the cart on each side.

Provision is made for letting off the water collected in the cart, by means of a pipe, having its interior orifice some inches above the level of the mud after settlement: the cart, when full, is drawn to the side of the street, at some distance from a sewer grid, and the pipe plug being withdrawn, the water flows into the channel. A slight modification of the original form of the machine, by bevelling the cogs of the large spur wheel, C, throws the machinery more to the near side, and enables it to sweep close up to the curbstone of the foot pavement; and the hands before required to clean out the gutters are now dispensed with. An indicator, attached to the side of the sweeping apparatus, shows the extent of surface swept during the day, and

acts as a useful check on the driver. It also affords the opportunity of hiring horses to work the machine over a given quantity of surface, the rate of hire being per 1000 yards actually swept. This will be found convenient where parties working the machine do not keep their own horses, and will tend to facilitate the introduction of the new system under management of the local authorities.

When provision cannot conveniently be made in large towns for deposit in yards at proper intervals, the patent machine is constructed of two parts, as above described, viz., an upper A', carrying a sweeping apparatus, and a lower A, consisting of a loose box, suspended from the upper, and capable of easy detachment. Each machine having two or more of these boxes, A, may be kept constantly at work, depositing the full box in a suitable place, and taking up an empty box before provided,—a skeleton cart being afterwards employed to convey the loaded boxes to the place of ultimate deposit. No difficulty has been found to arise in the management of the machine by ordinary drivers. It has been worked regularly on every kind of street surface—the round and square set stone,—the Macadamized road,—and the wood pavement; all of which are found in the districts before mentioned. Its peculiar advantage, as applied to wood pavement, in preventing the slippery state of the surface so much complained of, has attracted particular attention and will, no doubt, tend to facilitate the general introduction of that useful invention. By the use of proper precautions in cleaning and oiling the machine before setting it to work, the friction of the working parts may be materially reduced,—a point of great importance, in reference both to the consumption of horse power, and the cost of repairs. The wear of the brooms, which at first was considerable, has been diminished more than one-half, by the action of the regulating weights before mentioned. A product of South America, called by the Portuguese "Piassava," forms an excellent material for the beard of the brooms, having great pliancy and strength combined, and also remarkable degree of durability.

Two machines are advantageously worked together, one a little in advance of the other. Not only is the operation of cleansing a particular street thus effected more rapidly, but the two drivers can occasionally assist each other, and one of them (at higher wages) may exercise a supervision over both machines.

The success of the operation is no less remarkable than its novelty. Proceeding at a moderate speed through the public streets, the cart leaves behind it a well swept track, which forms a striking contrast with the adjacent ground. Though of the full size of a common cart, it has repeatedly filled itself in the space of six minutes from the principal thoroughfares of Manchester. This fact, while it proves the efficiency of the new apparatus, proves also the necessity of a change in the present system of street cleaning.

SUSQUEHANNA AND DELAWARE RAILROAD.

We have had placed in our hands "A Report of the survey of a route from the proposed Susquehanna and Delaware railroad—from Pittstown on the Susquehanna through the centre of the Lackawannock coal formation in Luzerne and extending through parts of Pike and Northampton counties, Pennsylvania to the Delaware river at the Water Gap—with an estimate of its cost by Ephraim Beach, Esq., Civil Engineer," with remarks on the same by the Pennsylvania commissioners and Henry W. Drinker, Esq.

This admirable project has slept for a long period. It was surveyed in 1831. As a record of the formation of that part of Pennsylvania, and for reference, we give Major Beach's survey, with some extracts from the views taken by the commissioners, as to the advantages of the route, and the cost of transportation—which at that time was entirely heterodox, and looked upon as the dream of a visionary, to state that coal could be transported with profit at 2½ cents per ton per mile, when it is now ascertained that on the Philadelphia and Reading railroad they can do it for one-fourth of this sum—and over the Boston and Albany railroad, where their grades are as high as 85 feet, they transport at 1½ cents per ton per mile.

We find there are two roads in New Jersey seeking extension to the Delaware river, and finally to connect with this projected railroad to the coal regions of Luzerne county, the one extending from Newark by Morristown, and the other from Elizabethtown to Somerville. There are no opposing obstacles to a railroad but a bridge over the Delaware, to reach both hard and soft coal. It is undoubtedly the shortest, the best and most level line from the city of New York to the Upper lakes, with the exception of the northern line by the pass at the Little Falls, Herkimer county, New York. From thence to near the foot of Niagara Falls, nearly a level can be obtained, on and near the ridge road—the supposed former shore of lake Ontario. On this line, as it can be formed with a descending grade from lake Erie at Buffalo to the Hudson, no route from the seaboard to the west can compete with it.

The route in question, with the exception of three planes, to be operated by water power, but which we learn have been dispensed with, at a less grade than those on the Massachusetts road—leads through the best part of New Jersey for agricultural and mineral products. Independent of the coal and iron of Pennsylvania, there are extensive forests of the best white, yellow and spruce pine, with other valuable timber, the necessity of which to advance the growth of this city, will make lumber a great item of freight and profit to the road.

This is not all—now that a difficulty and legal questions have been raised between the Hudson and Delaware canal and New York and Erie railroad, which threaten to drive the latter into Sullivan county, and if persisted in may prostrate or delay for a long period the construction of this work, it is a matter of much importance to the citizens of New York to encourage the construction of the Susquehanna and Delaware railroad, as an enterprise that will take produce and merchandize in 181½ miles from Hoboken to the Great Bend, on a line much shorter than via. Piermont, to lake Erie.

	<i>Miles.</i>
From Jersey City via. Paterson to the Water Gap,	91
From the Water Gap to the coal region, in quantities,	53
From thence and the mouth of Leggett's creek to the Great Bend,	
as surveyed by J. Seymour,	47½
	<hr/> 181½

Twelve miles from the mouth of Leggett's creek will connect this line with Carbondale. The distance to Tioga Point or to Athens near the State line from Jersey City has been ascertained to be 232 miles.

The commissioners remark, pages 35, 36 and 37:

"By the Susquehanna and Delaware railroad and its connections, we conceive the wants and interests of the western New York will be better accommodated than by any other line which has yet been, or indeed that can ever be projected. A connection with the inexhaustible bodies of the coal of Luzerne county, it is scarcely necessary to say, will soon be as vital to the interests of Western New York as to her great and splendid commercial capital; while the same line that amply supplies these wants affords a most extended market for her agricultural produce, and at the same time connects the interests of that State (by the shortest possible line) with the parent city, whose position and commercial advantages are without a rival. The certain improvement of the Susquehanna to the State line, leaves the great question to depend alone on the success of our contemplated undertaking—an undertaking which has in its favor, as is conceived, unrivalled advantages.

"Entering at the western extremity a coal field, the extent and facilities of which are without a parallel—connected by the most direct lines pronounced practicable, and by improved channels already in operation, with the two greatest cities in America, we appear to have from these alone all the advantages, that in other cases have been found to produce ample remuneration, and to render valuable, investments in all undertakings where coal has been the basis of the trade.

"By a section of the Susquehanna river the south western counties of New York would be fully accommodated, while one of the lines which have recently been examined by Mr. Seymour to the Great Bend, would perhaps be more desirable to other parts of the State, to Owego, Ithaca, etc.

"Much has been said and written on railroads and canals, alternately aiming to prove the superiority of the one over the other; it seems probable that difference of situation and circumstances may prove both parties to be right. *But a union of the two in our climate, and where it can be avoided seems generally undesirable.* It is in effect the union of January and May. And when heavy articles, and particularly coal, constitutes the bulk of the transportation, it seems additionally undesirable.

"To a great extent a railroad must lay idle during the closing of a canal, forming part of its line, whether this be three or four months of the year—it is in either case unprofitable.

"It is a loss of so much interest on the capital expended, and is chargeable with a proportion of the loss of attendance and of the decay of the work. It is attended by many other disadvantages and probably does not afford that perfect communication which the advanced and advancing age seems to demand.

"Under this view it does not appear improbable that this line, at no distant day, will be united by continued railroad, with both Philadelphia and New York.

"The value of a continued railroad to a city during the winter season, has in some degree been developed by the recent operations of the Baltimore and Ohio work; longer experience will exhibit other valuable results. Railroads, while accomplishing the object of affording constant and steady winter supplies of fuel at uniform prices, which to the poor and to a part of the middling classes (whose means arise from day to day) is very desirable.

would at the same time afford supplies of many articles tending to increase the comfort and convenience of the citizen, and to add value to a city winter residence. The earliest and latest fruits of the earth, and the products of agriculture would more freely abound, and be afforded at more equal and moderate prices; fresh milk, fresh butter, so desirable would always be attainable; game from the interior, in fine and perfect order, would reach the market in its season, and the enjoyments of the table would be increased. To the country on the other hand, fish, oysters, and the produce of the sea, would be liberally distributed, and indeed it would appear that the condition of all in town and country would be much improved, nor would the effect be less beneficial to the citizens and to the public at large in other respects; trade and commerce would be invigorated; the stagnation that is now felt between the fall and spring sales of various merchandize would in a degree be removed, the demand would be more timely and more extensive, the purchases less hurried and more considerable. The railroad system would tend much to equalize the periods and amount of labor, to distribute human effort more equally throughout the seasons; at the present, in the late fall months, and as we approach towards the close of the year, there exists for a time very active, perhaps excessive employment, much to do, perhaps an insufficiency of laborers, every thing hurried, and often imperfectly accomplished.

"Then, as the severity of the winter closes around us, we experience a state as unprofitable to the citizen as it is injurious to the public morals; a state by which every one loses, by which no one gains; an evil is at once created—the formidable evil of having nothing to do. It seems to be an unerring law of our nature, that wherever this state of things exists, the moral scale of humanity is inevitably lowered: it lays above all things at the root of poverty and pauperism; to remedy which, volumes have been written, and millions have been expended. Railroads have at least this advantage, that they do not add to the number of winter idlers, which cannot with the same truth be asserted of canals."

With respect to cost of transportation we find at that early period the following observations—pages 28, 29 and 31:

OF THE COST OF TRANSPORTATION.

"On this question we have seen very few distinct and intelligent statements by American Engineers.

"Even on canals the cost of transportation presents nothing uniform, but is affected by the location, capacity, and construction of the several works. On some of the Pennsylvania canals, the calculations result in a cost of one half cent per ton per mile, while in other cases a much higher rate is assumed. Captain Beach does not go into any minute examination of the subject; he states generally the average of tolls and transportation on the canals $2\frac{1}{2}$ cents per ton per mile, and these charges are noted as probably applicable to the Susquehanna and Delaware railroad.

"As the cost of transportation will materially affect the price of coal at market, we are desirous, if possible, of arriving at more distinctness on this point.

"Some recent English publications reduce the cost of transportation on railroads to apparently so small an amount as to have excited doubts of the correctness of their estimates, an examination however of the separate items of charge, etc., on which these estimates are founded, in a great measure remove these doubts. In a note appended to "A Report descriptive of a route for a rail road from the Hudson, through Paterson to the Delaware river

at the Water Gap, and made by Col. Sullivan," we find the following: Mr. Booth in his account of the Liverpool and Manchester railroad computes all expenses, *including assisting engines at the inclined planes*, the water stations, and $7\frac{1}{2}$ per cent interest on capital, supposing full employ, at 164-1000ths of a penny per ton per mile," a little more than three mills of our money.

"Mr. T. Earle, in his recently published treatise on railroads, estimates the performance of a single horse to be equal to the transport of 416 tons, one mile per day, making sufficient allowance for wagon hire, and for horse and attendant we find the transportation on a railroad by animal power to be about half a cent per ton per mile.

In the Report of the Pennsylvania Board of State Canal Commissioners on the Carbondale railway it is stated—

"The Company at a profit transport across the 16 miles of railway, at 35 cents per ton, exclusive of the toll." From other data furnished by the same report, it is evident that this charge might be reduced and leave sufficient to pay expenses. In another statement made at a different time by the engineer of that company, as cited by Col. Sullivan, the expenses of conveyance over the 16 miles of rail, requiring five stationary steam engines, is reported at 29 $\frac{1}{4}$ cents. It is perfectly evident that these calculations have been predicated upon the actual amount transported, or expected to offer for transportation, at different periods during the year; and they are not based upon any estimate of the ascertained or probable capacity of the railroad. It is also equally manifest, that the cost of transportation over 16 miles, including *the whole ascent* in the direction of the trade, cost, fuel, and attendance at five stationary steam engines, with their ropes and apparatus within that distance, cannot furnish data for estimating the aggregate cost of transportation on a longer line comprising far more favorable sections—level planes, and all the descents.

"To throw some additional light on this subject, we avail ourselves of some data furnished by Mr. Seymour, in his report on a survey made by him in May, 1831, for the Lackawannack and Susquehanna railroad. In addition to his own authority we have the concurrent testimony of an engineer upon the only line of railroad improvement on our side of the water, which has as yet afforded experimental and practical illustration.

Mr. Seymour remarks—"It gives me pleasure to add, that upon showing the estimate to Mr. Archibald, the engineer for the Hudson and Delaware Canal Company, it met with an almost exact concurrence of opinion."

"We, therefore, conclude that, on favorable railroad lines, half a cent per ton per mile would probably meet the necessary expenditure for transportation, and that 1 cent per ton per mile will be an ample and sufficient estimate for the freight upon the Susquehanna and Delaware railroad when fairly in operation. The provisions of the act of incorporation give no limit to the charges for transportation, nor are we restricted to any per centage in this particular, all persons have liberty to use the railroad and transport upon it, they using the carriages, etc., as prescribed by the company."

NEW YORK AND ERIE RAILROAD.

The bill in aid of this road having passed the last legislature, arrangements are about being made preparatory to recommencing the work. This bill, the details of which have been before published in this Journal, postpones the sale of the road to 1850, and so far releases the State lien on the

work as to allow of other loans taking precedence of the three millions of State loan.

Meanwhile the residents along the line for several miles beyond Goshen, prompted by a sound and judicious policy have completed the road in their section at their own cost.

IRON CANAL BOATS.

In your March No. 354, vol. X., page 173, I gave you a short article on this subject, and expressed the wish "that some of our enterprising forwarders will try the experiment of Iron Canal Boats." I am gratified to find a morning paper has the following, showing the complete success of this class of boats. In another article I proved, that their light draught of water, with increased cargo, would so add to the capacity of the Erie canal, even without taking into view the rapid decrease of the forest, as to render the enlargement of the Erie canal entirely unnecessary. This was more than two years ago. It is desirable to ascertain the cost of an Iron Canal Boat, compared with our best lake boats—the draught of water in each, with tons carried.

IRON BOATS AND ERICSSON PROPELLERS.

"New and wider spheres of enterprise open upon us every year; and none has been more marked in this respect than the present year. We found yesterday at one of the lower piers in South street, the iron boat Pilot, with Ericsson propellers, (belonging to Mr. Asa Worthington, of the Hope Mills in Front street,) loading for St. John, at the farther end of lake Champlain. She is the first boat which has done this. Freight she has offered much more than she can carry. At Coentie's Slip lay a large schooner with Ericsson propellers loading for Hartford, Ct. Iron boats now load at Philadelphia with coal, and proceed to Troy or to any other point where their cargoes are wanted, and then load again with salt or whatever else is offered in return. The effort to avoid transshipment is constantly succeeding more and more, and boats are being built which can pass through all varieties of navigation. To work cheaper and to work faster is the thing to which every one aims."

Our canal commissioners should institute this enquiry. The expense would not be much and would lead to important results.

J. E. B.

STATISTICS OF LAKE STEAMERS.

The Buffalo Commercial Advertiser, on the completion of a quarter of a century since the first steamer was launched upon the western lakes, give a list of the steam vessels now on those waters. The total tonnage is 27,000, the cost \$3,510,000 or \$130 per ton.

The following remarks which we extract will prove interesting:

"In examining the progress of steam, as applied in-propelling vessels on the lakes, we are struck with the very small number of disasters when compared with other sections of the country, especially on the western waters. In the whole period of 25 years there have been but four explosions which might be termed serious. It is true there are other disasters to re-

cord, whose calamitous details are too freshly impressed upon the public mind. The following tabular view presents both these classes:

<i>Explosions—Lives lost.</i>		<i>Burned—Lives lost.</i>	
Peacock, September 1830,	15	Washington, 2d June, '38,	50
Adelaide, June, 1830,	3	Erie, August, 1841,	250
Erie, August, 1840,	6	Vermillion, Nov. 1842,	5
Perry, twice in 1835,	6	Caroline, (wilful)	5
Total,	30	Total,	310

The number of boats yet remaining of the whole once in commission on lake Erie and the upper lakes is about sixty, with an aggregate of 17,000 tons. Of these some thirty-five only are used when the consolidation is in existence.

Of the whole number of boats in commission during the above period only ten were built and owned in Canada.

The first steamer known to be upon lake Michigan was the Henry Clay. In August, 1827, an excursion of pleasure was made in her to Green Bay, where Gov. Cass was holding a treaty with the Winnebagoes. After the treaty was concluded, Gov. C. and suite returned in the Clay. From that period to 1832 some of the boats went to Green Bay, but no further. On the breaking out of the Black Hawk war several of the larger boats were chartered by the government to convey troops to the disaffected territory, and Chicago for the first time was greeted with the sight of one of those strange visitors.

From the following notice we learn that two men, L. A. Sykes and Geo. S. Mills, have leased the Morris canal. From the enterprise and intelligence of these gentlemen we have no doubt that this work will be judiciously managed, and we hope with profit to the lessees.

"The Morris canal is again in navigable order, and business has been resumed through the enterprise of the new lessees, Messrs. George S. Mills and L. A. Sykes, with good promise of a brisk and profitable season. Full supplies of coal will, we understand, be sent down to market through this channel from the Lehigh mines by the Pennsylvania companies. We are also gratified to learn that the iron business at the various establishments on the route has been resumed and is to be extended during the season. The Stanhope Works are to be put in full operation, and, in addition to the old works at Boonton, a large nail factory is now in progress by a New England Company, which will be completed in the course of 60 days, and which is then expected to turn out some tons of nails daily. Preparations have also been made for the transmission of large supplies of ore from the rich iron mines of Morris county. There is very little, if any richer ore in the country than that furnished by Gov. Dickerson's mines at Sucasunna."—*Newark Daily Advertiser*.

THE PYRAMIDS OF GIZEH.

At the Royal Institute of British Architects, on the 6th ultimo, a letter was read from Mr. Perring, containing some remarks on the great Pyramid, accompanied by a model.

The model is on a scale of 30 feet in the inch, and represents the pyramid in its original condition,—that is, immediately after the sarcophagus was placed therein, and before the passages were filled with stone blocks closing the entrance. From an examination of the ancient Egyptian cubit, now remaining, I deduced the length to be 1.713 English feet divided into

four palms, each of seven digits. This measure, when applied to the pyramids, agrees as closely as to render its correctness certain, and I proceed to mention a few of the more obvious results in the edifice before us. The base covered a square of 448 cubits on each side, which, from a statement of Pliny, I take to have been equal to eight Egyptian jugera, or acres; and this supposition is somewhat confirmed by finding the second pyramid would then cover seven, and the third, one and three quarters of these supposed jugera, and so on with the other pyramids of Egypt. The height of the great pyramid appears to have been 280 cubits, being a proportion of height to side of base of 5 to 8; and I may here mention that several other pyramids have the same proportions. This gives the following ratio on a direct section: As half the base is to the perpendicular height, so is the apotheme, or slant height to the whole base; or for each side it may be thus stated as

Rad : Tang :: Sec : 2 Rad.

"Sir John Herschel having the angles only of the pyramids and their passage before him, gave his decided opinion that they were "not connected with any astronomical fact, and probably adopted for agricultural reasons; and the knowledge of the above proportions will I think lead to the same conclusion: for with the most solid and enduring shape possible, the builders obtained a mathematical symmetry which no other proportions could give. Although this pyramid was nearly 480 feet in perpendicular height of solid masonry, the pressure of the solid mass is so distributed, that the lower courses have only to sustain about 25,000 lb.; therefore it is evident that the main objects of the architect—viz., stability and eternal duration—were well effected. The inclination of the entrance passage of the great pyramid was regulated by a proportion of 2 to 1: that is, two feet horizontal to one foot perpendicular.

"The same mode of regulating the angles is observable in every instance; thus where inclined blocks were used to cover an apartment, a certain portion of the width of the room was taken for the rise or pitch; as in the queen's chamber, where the rise is a third of the width of the apartment, and also the angle of the air passages leading from the king's chamber to the exterior, have a rise of one perpendicular to two horizontal. From finding in every case that the angles were thus regulated, I have come to the conclusion that the Egyptians, at the time of the erection of these mighty monuments, possessed no knowledge of the division of the circle into degrees, but that their angles were regulated by the proportion of base to perpendicular height; in fact, the tangential measure of the angle, and not its abstract measurement. That they learned to divide the circle into degrees at a later period is highly probable, as they were celebrated for their astronomical knowledge.

"In every part of the pyramids evidences of premeditated and careful design are apparent; but my present purpose is to draw attention to the more striking points in the general pyramid only. The situation of the apartments in the pyramid appear to have been regulated as follows—

Height from base (external) to floor of passage of queen's chamber	40 cubits
From the above to floor of king's chamber, or principal apartment	40 "
From the above to top of upper chamber	40 "
From the above to apex of pyramid	160 "


Total 280 cubits


Making 280 cubits in perpendicular height, as above stated. The floor.

of the subterranean apartment was also 60 cubits below the base of the pyramid."

THE THAMES TUNNEL.

This important undertaking was opened for foot passengers on the 25th of March last. Thus, after many years of anxiety and difficulty, perhaps without parallel in the history of great public works, the practicability of forming a thoroughfare for carriages and foot passengers under a deep navigable river, and without interruption to the navigation, is proved and executed. The obstacles, which have from time to time impeded, and all but stopped the progress of the tunnel, have been numerous. The work was commenced in 1825, but was stopped in 1828 by an irruption of the Thames. From that time to the spring of 1835 no progress was made. In this year, under the sanction of an Act of Parliament, the Treasury allowed the Exchequer Loan Commissioners to advance, out of the grant voted for public works, the money necessary to complete the tunnel; and it was again commenced and has been continued with but few inevitable interruptions and delays to the present time, when, as the directors have stated, it is securely completed, and is now thrown open to the public as a thoroughfare for foot passengers. The two roadways for carriages under the river are also perfectly completed. From its commencement to the present date there has been but 11 years within which the excavation could be carried on. And during this time, for nearly two years or ninety-nine weeks, the works were suspended from circumstances beyond the control of either the directors or the engineer. The work has been in fact executed in about 9 years of actual work, at a cost of about £446,000, including property and expenses of every kind, with the particulars of which the proprietors have been accurately and annually acquainted. The actual tunnel of 1200 feet was executed in eight years. The carriage-way descents are now alone wanting to complete the work. They are susceptible of being contracted for in the ordinary way.

 The editors of the Railroad Journal present their compliments to the *Officers, Engineers, and Superintendents* of Railroads, and request them to furnish for publication in its pages, any interesting or important fact which their experience may have established calculated to present the subject of railroads in its true light. Facts, *well established facts*, properly spread before this enlightened community are only necessary to ensure a gradual but *constant* extension and improvement of railroads in this country; and who can so readily furnish such facts as those constantly engaged in the construction and management of railroads? and what medium of publication so proper as the Railroad Journal? When important facts are furnished for *first* publication in the Journal, measures will be taken to give them extensive circulation through the newspaper press of the country, by sending *slips* to several hundred editors—and requesting its republication.

 Correspondents are requested to send in their communications early, as it is intended hereafter to issue the Journal and despatch it to subscribers, *before* the first of each month.

ERRATA—Page 161, tenth line from top, for "260 or thereabouts," read

240 in number. Same line, for "about eleven feet," read *ten feet*. Page 162, 14th line from top, for "of eleven feet," read of *ten feet*; 16th line from top, for "about eight feet," read *seven and a half feet*.

The March number of the Journal, which was passed over in order to come up with the train, will be issued and sent out with the number for July, and thus be again even with our cash subscribers, when—it cannot be doubted—others will make matters even with us for the past, and right for the future—in advance. Good fuel, and plenty of it, is essential to attain high velocities with the Locomotive—so also, is it important to the future success and improvement of this Journal, that arrearages should be liquidated, and none be allowed hereafter, to arise.

After a retirement of three years from all connection with its concerns, the undersigned again resumes his former station, in connection with his late associate, Mr. Geo. C. Schaeffer, as Editor and Publisher of the Railroad Journal, and Mechanics' Magazine. His retirement was from *necessity*, and a source of deep regret; his return is from *choice*, and, in the hope of contributing in some degree to make the Journal useful to the cause for which it has so long labored, highly gratifying to him.

The Journal, on its first appearance, January 1st, 1832, was cordially and generously greeted by the press throughout the country; and also by gentlemen connected with the *few* railroads then under construction; and, notwithstanding the oddity of its title, and the doubts of many as to the possibility of finding materials even to give a *tone* to its pages, much less to fill them, its course for several years was *onward*; but the *great fire* of December 1835, and the general depression of business for several years past, has borne heavily upon it. It has, however, been continued until the present period, from whence it is believed that we may look forward to more prosperous times: and to a gradual but *certain* extension and improvement of the railroad system; and it is now designed to make an effort to extend the circulation of the Railroad Journal, and increase its usefulness, by *reducing the price, stereotyping its pages, and issuing it punctually*.

To insure the success of the Journal under the new arrangement, a renewal of the courtesies of the *Press* and the friendly efforts of those interested in, or connected with, the works of internal improvement and the mechanic arts, throughout the country are respectfully solicited, and will be duly appreciated.

D. K. MINOR.

New York, May, 1843.

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DETERIORATION OF WROUGHT IRON AXLES.

Since the Paris railroad accident, much discussion has arisen as to the character of iron and mode of manufacture of axles. It is contended that those axles which have broken apparently from a flaw in the iron, have in reality become changed throughout their mass—that the fibrous structure of wrought iron is changed in course of time into a cristalline and brittle grain—and that these changes occur in the best made axles, and in the best quality of iron, and that they are produced by long continued use.

How far these assertions are correct it is difficult to say, the interest of manufacturers is to shorten as much as possible the period during which an axle can be worked with safety; on the other hand it is probable that the consumers are willing to believe that the longest possible period that can be named is more near the truth. Some of the statements made in foreign Journals are evidently influenced in the manner first named. Still we should be cautious about denying that any change of this kind does take place, as it is well known that a similar gradual passage to the cristalline structure is known to take place in other metals and in alloys. It is not unlikely that the vibration throughout the iron, caused by the constant jar of passing over the rails, may produce this change with rapidity.

A writer in the Civil Engineer and Architects Journal gave in confirmation of this theory the statements of a French manufacturer of great experience. This gentleman has arrived at the conclusion that an axle can only safely run about 75,000 miles; after that time it is his constant practice to take it out, place it between two new bars of iron, and weld the whole together into a new axle. He also states that when paved roads are passed over, the distance run is not so great to produce the same effects, and that according to his experience the wear of the collar is a direct measure of the length of time during which the axles may be considered safe.

From the statements which may at least be considered as not far from the truth, we may infer that the character of the road will greatly influence the duration of the axles—that a firm, hard and unyielding structure will cause

their more rapid deterioration, while a more elastic road, if well laid and constantly kept in repair, may allow of their use for an indefinite period. It is to this cause that we attribute the want of coincidence of the experience of this country and that of Europe. That a time will arrive, beyond which it will not be safe to use an axle, no matter how favorable the structure of the road, there can be no doubt—the only question is, what this time may be. The experience of many years will probably be required to determine the question.

The want of precise information upon this point, need not, however, deter us from attempting to prevent or retard such changes in iron. The manner in which this may be accomplished can only be ascertained by experiment, yet useful suggestions may be made derived from correct reasoning upon well ascertained facts, or from the small amount of experience now in our possession. The most simple suggestion which has been made is this. The same alteration takes place under the influence of heat improperly applied, it is therefore a question whether the electricity or magnetism developed by friction may not be in some measure the agent in producing a crystalline structure. It is proposed, therefore, to reverse the motion of the axle so as to prevent this action, or rather that the effects produced by motion in one direction may be neutralized by motion in the other direction.

Another proposal which we have to make, is that the axle should be loaded with pieces of iron or lead fastened upon it at one or more points, and that the position of these should be from time to time changed; by this means the direction and force of the vibrations will never be the same for any great length of time, and the crystalline texture may thus be prevented from assuming that regularity of grain which renders the mass brittle.

Since writing the above, we have obtained a copy of the paper of Mr. Charles Hood upon this subject, which seems so much to the purpose that we insert the whole of it.

CHANGES INDUCED IN THE STRUCTURE OF IRON SUBSEQUENT TO MANUFACTURE.—BY CHARLES HOOD, ESQ., F.R.A.S.

The important purposes to which iron is applied have always rendered it a subject of peculiar interest; and at no period has its importance been so general and extensive as at the present time, when its application is almost daily extending, and there is scarcely anything connected with the arts, to which, either directly or indirectly, it does not in some degree contribute. My object in the present paper is to point out some peculiarities in the habits of iron which appear almost wholly to have escaped the attention of scientific men; and which although in some degree known to practical mechanics, have been generally considered by them as isolated facts, and not regarded as the results of a general and important law. The circumstances, however, well deserve the serious attention of scientific men, on account of the very important consequences to which they lead. The two great distinctions which exist in malleable wrought iron, are known by the names of "red-short" and "cold-short" qualities. The former of these comprises the tough fibrous iron, which generally possesses considerable strength when cold; the latter shows a bright crystallized fracture, and is very brit-

de when cold, but works ductile while hot. These distinctions are perfectly well known to all those who are conversant with the qualities of iron; but it is not generally known that there are several ways by which the tough red-short iron becomes rapidly converted into the crystallized, and by this change its strength is diminished to a very great extent.

The importance which attaches to this subject at the present time, will not I think, be denied. The recent accident on the Paris and Versailles railway, by which such a lamentable sacrifice of human life has occurred, arose from the breaking of the axle of a locomotive engine, and which axle presented at the fractured parts the appearance of the large crystals, which always indicate cold-short and brittle iron. I believe there is no doubt however, that this axle, although presenting such decided evidence of being at the time of this accident of the brittle cold-short quality, was at no distant period tough and fibrous in the highest degree. I propose, therefore, to show how these extraordinary and most important changes occur, and shall point out some at least of the modes by which we can demonstrate the truth of this assertion by actual experiment.

The principal causes which produce this change are percussion, heat, and magnetism; and it is doubtful whether either of these means *per se* will produce this effect; and there appear strong reasons for supposing that, generally, they are all in some degree concerned in the production of the observed results.

The most common exemplification of the effect of heat in crystallizing fibrous iron, is by breaking a wrought iron furnace bar, which, whatever quality it was in the first instance, will, in a short time, invariably be converted into crystallized iron; and by heating, and rapidly cooling, by quenching with water a few times, any piece of wrought iron, the same effect may be far more speedily produced.

In these cases we have at least two of the above causes in operation—heat and magnetism. In every instance of heating iron to a very high temperature, it undergoes a change in its electric or magnetic condition; for, at very high temperatures, iron entirely loses its magnetic powers, which return as it gradually cools to a lower temperature. In the case of quenching the heated iron with water, we have a still more decisive assistance from the electric and magnetic forces; for Sir Humphry Davy long since pointed out (*Chem. Phil.*, p. 138) that all cases of vaporization produced negative electricity in the bodies in contact with the vapor—a fact which has lately excited a good deal of attention, in consequence of the discovery of large quantities of negative electricity in effluent steam.

These results, however, are practically of but little consequence; but the effects of percussion are at once various, extensive, and of high importance. We shall trace these effects under several different circumstances.

In the manufacture of some descriptions of hammered iron, the bar is first rolled into shape, and then one-half the length of the bar is heated in a furnace, and immediately taken to the tilt-hammer and hammered; and the other end of the bar is heated and hammered in the same manner. In order to avoid any unevenness in the bar, or any difference in its color, where the two distinct operations have terminated, the workman frequently gives the bar a few blows with the hammer on that part which he first operated upon. That part of the bar has, however, by this time become comparatively cold; and if this cooling process has proceeded too far when it receives this additional hammering, that part of the bar *immediately* becomes crystallized, and so extremely brittle that it will break to pieces by merely throwing it on the ground, through all the rest of the bar will exhibit the best and

toughest quality imaginable. This change, therefore, has been produced by percussion (as the primary agent,) when the bar is at a lower temperature than a welding heat.

We hear see the effects of percussion in a very instructive form. And it must be observed that it is not the excess of hammering which produces the effect, but the absence of a sufficient degree of heat at the time the hammering takes place; and the evil may probably be all produced by four or five blows of the hammer, if the bar happens to be of a small size. In this case we witness the combined effects of percussion, heat, and magnetism. When the bar is hammered at the proper temperature, no such crystallization takes place, because the bar is insensible to magnetism. But as soon as the bar becomes of that lower degree of temperature at which it can be affected by magnetism, the effect of the blows it receives is to produce magnetic induction; and that magnetic induction and consequent polarity of its particles, when assisted by further vibrations from additional percussion, produces a crystallized texture. For it is perfectly well known that in soft iron, magnetism can be almost instantaneously produced by percussion; and it is probable that the higher the temperature of the bar at the time it receives the magnetism, the more likely will it be to allow of that re-arrangement of its molecules which would constitute the crystallization of the iron.

It is not difficult to produce the same effects by repeated blows from a hand-hammer on small bars of iron; but it appears to depend upon something peculiar in the blow, which, to produce the effect, must occasion a complete vibration among the particles in the neighborhood of the part which is struck. And it is remarkable that the effects of the blows in all cases seem to be confined within certain limited distances of the spot which receives the strokes. Mr. Charles Manby has mentioned to me a circumstance which fully bears out this statement. In the machine used for blowing air at the Beaufort iron works, the piston rod of the blowing cylinder, for a considerable time, had a very disagreeable jar in its motion, the cause of which could not be discovered. At last the piston rod broke off quite short, and close to the piston; and it was then discovered that the key had not properly fastened the piston and rod together. The rod, at the fracture, presented a very crystallized texture; and as it was known to have been made from the very best iron, it excited considerable surprise. The rod was then cut at a short distance from the fracture, and it was found to be tough and fibrous in a very high degree—showing what I have already pointed out, that the effects of percussion generally extend only a very short distance. In fact, we might naturally expect, that as the effect of vibration diminishes in proportion to the distance from the stroke which produces it, so the crystallization, if produced by this means, would also diminish in the same proportion. The effect of magnetism alone may also be estimated from this circumstance. The rod would of course be magnetic throughout its whole length, this being a necessary consequence of its position, independent of other circumstances; but the necessary force of vibration among its particles only extended for a short distance, and to that extent only did the crystallization proceed. The effect of magnetism in assisting the crystallization, I think it unnecessary to dwell upon, as the extensive use of galvanic currents in modern times has fully proved their power in crystallizing some of the most refractory substances; but by themselves they are unable to produce these effects on iron, or at least the operation must be extremely slow.

Another circumstance which occurred under Mr. Manby's observation, confirms generally the preceding opinions. A small bar of good tough iron

was suspended and struck continuously with small hand hammers, to keep up a constant vibration. The bar, after the experiment had been continued for some considerable time, became so extremely brittle, that it entirely fell to pieces under the light blows of the hand hammers, presenting throughout its structure a highly crystallized appearance.

The fracture of the axles of road vehicles of all kinds is another instance of the same kind. I have at different times examined many broken axles of common road vehicles, and I never met with one which did not present a crystallized fracture; while it is almost certain that this could not have been the original character of the iron, as they have frequently been used for years with much heavier loads, and at last have broken, without any apparent cause, with lighter burdens and less strain than they have formerly borne. The effects, however, on the axles of road vehicles are generally extremely slow, arising, I apprehend, from the fact that, although they receive a great amount of vibration, they possess a very small amount of magnetism, and are not subject to a high temperature. The degree of magnetism they receive must be extremely small, from their position and constant change with regard to the magnetic meridian, the absence of rotation, and their insulation by the wood spokes of the wheels. Whether the effects are equally slow with iron wheels used on common roads, may perhaps admit of some question. With railway axles, however, the case is very different. In every instance of a fractured railway axle, the iron has presented the same crystallized appearance; but this effect, I think, we shall find is likely to be produced far more rapidly than we might at first expect, as these axles are subject to other influences, which, if the theory here stated be correct, must greatly diminish the time required to produce the change in some other cases. Unlike other axles, those used on railways rotate with the wheels, and consequently must become, during rotation, highly magnetic. Messrs. Barlow and Christie were the first to demonstrate the magnetism, by rotation, produced in iron; which was afterwards extended by Messrs. Herschel and Babbage to other metals generally, in verifying some experiments by M. Arago. It cannot, I think, be doubted that all railway axles become from this cause, highly magnetic during the time they are in motion, though they may not retain the magnetism permanently. But in the axles of locomotive engines, we have yet another cause which may tend to increase the effect. The vaporization of water, and the effluence of steam, have already been stated to produce large quantities of negative electricity in the bodies in contact with the vapor; and Dr. Ure has shown (*Jour. of Science*, vol. v. p. 106) that negative electricity, in all ordinary cases of crystallization, instantly determines the crystalline arrangement. This, of course, must affect a body of iron in a different degree to that of ordinary cases of crystallization; but still we see that the effects of these various causes all tend in one direction, producing a more rapid change in the internal structure of the iron of the axle of a locomotive engine than occurs in almost any other case.

Dr. Wollaston first pointed out that the forms in which native iron is disposed to break are those of the regular octahedron and tetrahedron, or rhomboid, consisting of these forms combined. The tough and fibrous character of wrought iron is entirely produced by art; and we see in these changes that have been described an effort at returning to the natural and primal form—the crystalline structure, in fact, being the natural state of a large number of the metals; and Sir Humphry Davy has shown that all those which are fusible by ordinary means assume the form of regular crystals by slow cooling.

The general conclusion to which these remarks lead us, appears, I think,

to leave no doubt that there is a constant tendency in wrought iron, under certain circumstances, to return to the crystallized state; but that this crystallization is not necessarily dependent upon time for its development, but is determined solely by other circumstances, of which the principal is undoubtedly vibration. Heat, within certain limits, though greatly assisting the rapidity of the change, is certainly not essential to it; but magnetism, induced either by percussion or otherwise, is an essential accompaniment of the phenomena attending the change.

At a recent sitting of the Academy of Sciences at Paris, M. Bosquillon made some remarks relative to the cause of the breaking of the axle on the Versailles railroad; and he appears to consider that this crystallization was the joint effect of time and vibration, or rather, that this change only occurs after a certain period of time. From what has here been said, it will be apparent that a fixed duration of time is not an essential element in the operation: that the change, under certain circumstances, may take place instantaneously; and that an axle may become crystallized in an extremely short period of time, provided that vibrations of sufficient force and magnitude be communicated to it. This circumstance would point out the necessity for preventing as much as possible all jar and percussion on railway axles. No doubt, one of the great faults of both engines and carriages of every description, but particularly the latter, is their possessing far too much rigidity; thus increasing the force of every blow produced by the numerous causes incidental to railway transit, by causing the whole weight of the entire body in motion to act by its momentum, in consequence of the perfect rigidity of the several parts, and the manner of their connection with each other, instead of such a degree of elasticity as would render the different parts nearly independent of one another in the case of sudden jerks or blows; and which rigidity must produce very great mischief both to the road and to the machinery moving upon it. The looseness of the axles in their brasses must also be another cause which would greatly increase this evil.

Although I have more particularly alluded to the change in the internal structure of iron with reference to the effects on railway axles, it need scarcely be observed that the same remarks would apply to a vast number of other cases, where iron, from being more or less exposed to similar causes of action, must be similarly acted upon. The case of railway axles appears to be of peculiar and pressing importance, well deserving the most serious consideration of scientific men, and particularly deserving the attention of those connected with railways, or otherwise engaged in the manufacture of railway machinery, who have the means of testing the accuracy of the theory here proposed; for if the views I have stated be found to harmonize with the deductions of science, and to coincide with the results of experience, they may have a very important effect upon public safety. It may be observed on the other hand, however, that at the present time all railway axles are made infinitely stronger than would be necessary for resisting any force they would have to sustain in producing fracture, provided the iron were of the best quality; and to this circumstance may perhaps be attributed the comparative freedom from serious accidents by broken axles. The necessity for resisting flexure and the effects of torsion, are reasons why railway axles never can be made of such dimensions only as would resist simple fracture; but it would be very desirable to possess some accurate experiments on the strength of wrought iron in different stages of its crystallization, as there can be no doubt that very great differences exist in this respect; and it is probable that in most cases, when the crystallization has once commenced, the continuance of the same causes which first produced it goes on continu-

ally increasing it, and thereby further reduces the cohesive strength of the iron.

PROFESSIONAL EMPLOYMENT.

There are several very common misapprehensions in regard to Civil Engineers which we conceive to be the cause of much loss, to the profession of employment, and to the public of valuable services, obtainable at not greater cost than the less valuable substitute commonly resorted to. It is of the highest consequence to the profession that these errors should be corrected fully and promptly.

The public estimate of the proper sphere of engineering duty, is limited to the construction of railroads, canals, and sometimes, bridges. The construction, as well as the laying out of common roads, the building of piers, wharves, sea-walls, etc., of the large majority of bridges, of large edifices whose strength depends entirely on the disposition of material—all these, and many other labors belonging properly and exclusively to the profession of civil engineering, are almost universally assigned to those who should not be permitted to venture beyond the mechanical duties of construction under some competent superintendence.

In bridges, and other large structures, it is customary to employ no other engineer than the builder, constructor or contractor himself. The impropriety of this proceeding would, we should think, be so manifest that no one consulting his own interest would attempt it. That the same person should, both plan the work and construct it, and thus become a judge of his own performance is a most unusual mode of doing business.

The popular mistakes upon this point, have arisen from the constant demand for engineers upon our railroads and canals having until recently allowed no opportunity for their employment upon other works—even if it had been desired. We should not think there could be any doubt as to the capacity of a properly instructed engineer. The nature of his profession is such that he is compelled to pay attention to many and diverse modes of construction, and to the general applications of physical science. In fact the education of a civil engineer embraces the full consideration of all the arts of construction, and he is therefore a better projector of building than either a carpenter or a mason.

The unfrequent employment of our own civil engineers in other than works of public improvement, has in a measure arisen from the vast numbers of needy adventurers from abroad who have hitherto forced themselves into all situations of this kind. Men unknown at home, have pretended to instruct the whole profession in this country—and in several instances it has been shown that these very men have never been previously employed in any other than subordinate situations, such as do not even require any acquaintance with the profession of those by whom they are employed.

The results of this practice have been doubly disadvantageous, by exclu-

ding our own engineers from employment, and also by throwing discredit upon the very name of civil engineer.

At the present time when but few railroads or canals are in process of construction, a large number of well informed and capable civil engineers are without anything to do. The resort to such men for advice, would not only be employment to them, but profit to those consulting. This subject is deserving of consideration by all parties. If much skill and intelligence now remains unemployed and may by any arrangement be brought into use, this certainly would be a public benefit, as well as an individual accommodation.

PRACTICAL REMARKS ON BLAST FURNACES.—BY GEO. THOMSON, ESQ., MINING ENGINEER.

[Read before the Glasgow Philosophical Society, 4th January, 1843.]

There is a manifest absence of anything like correct principle in iron smelting; and although the reduction of ore by cementation may be an easily explained operation, yet, the peculiar combinations brought to bear in the blast furnace, seem to present a problem which chemical science is as yet unable to explain.

In the attempted solutions of the problem, a too limited number of facts have been generally considered, and generalizations attempted, from facts bearing partially on unvaried conditions. Following the system of induction, if a true principle is only to be attained through the medium of facts in every variety and under every possible condition, the object may be assisted, in some measure, by my laying before the society a few facts which have come under my own observation, and may be peculiar. The results given are divided into three principal conditions; viz., 1st, as respects the direct influence, *ceteris paribus*, of different material. 2d, influence of shape and size. 3d, influence of blast, as to diffusion, pressure, or quantity.

1st, *Influence of material*.—Although all the materials used in smelting have a certain influence; it is the coal which gives the most extraordinary results as respects "yield." A few results of various coals are therefore collected into the following table from my own immediate observation. The word "yield," is used to denote the comparative quantity of coals used in the furnace, to produce, or to smelt a ton of iron. In the table, the weekly quantity of iron given, as produced by hot blast, is small in comparison with what is now made at most furnaces; yet these are the more correct *comparative* results, having been attained with like conditions of size shape, number of tweres, etc. Since that time, the shape and size of furnaces have been materially altered, as well as other conditions, and the make greatly increased.

Referring to the table, the first three coals are found in the same coal-field and at no very great depth from each other. The cold blast results of these came directly under my own observation, and are taken from several years' work; the hot blast results are from a neighboring work, and subject to similar conditions in almost every respect. Here, then, in the same coal-field are three different coals, which, when under similar conditions with cold blast, give very different results; so much so, as to have taken nearly twice as much of one kind of coal to make a ton of iron as of another (yard coal $6\frac{1}{2}$ tons, clod coal 3 tons;) but when the hot blast is applied, we find they are very nearly assimilated, so that, upon the coal which works best with cold blast, that application has scarcely any effect, while on the inferior coal it has a most surprising one.

TABLE No. I.

PLACES.	COALS.			RESULTS.			
	No.	Local name.	Loss in Coking.	COLD BLAST.		HOT BLAST.	
				Coal to a ton of iron from furnace.	Wear & tear of iron from furnace.	"Raw," or Coked.	Coal to a ton of iron from furnace.
SHROPSHIRE, (Lighthoor Works,)	1	Clod Coal,	45 per cent.	3 Tons.	70 Tons.	Coked.	2½ Tons.
	2	Yard Coal,	50 —	5 to 5½	40	Coked.	2½ to 3
	3	Little Flint Coal, Do.	50 —	4	50 to 60	Coked.	2½ to 3
SOUTH STAFFORDSHIRE, (Wedensbury Work,)	4	Thick Coal,	Uncoked.	2½ to 3	50 to 60	Raw.	2½
	5	Tipton Coal,	45 —	3	60	Raw.	2½
NORTH STAFFORDSHIRE, (Fenton Park,)	6	Ash Coal,	50 —	5½	35	½ Coke, ½ Raw.	3½
	7	Rider Coal,	55 —	7½	25	Coked.	4½

DESCRIPTION OF COALS.

No. 1 is soft, stratified, and dull; horizontal sections filled with carbonaceous matter; burns with a white ash; produces a soft coke, which retains carbonaceous matter in divisions.

No. 2. Rather hard, cubical and bright; calcareous matter in transverse divisions; burns to a brown ash; produces a hard coke, and is considered very sulphury.

No. 3. Hard, cubical, shining; burns to a white ash; produces a very hard coke.

No. 4, is of various stratifications, differing in character; is generally known.

No. 5. Schistous, very friable, with carbonaceous matter between horizontal layers.

No. 6. Bright, conchoidal, free burning, and renders a white ash; is preferred for burning the china and "pottery ware" of the district.

No. 7. Bright, conchoidal, burns very hot, leaves a brown ash. A stratum of pyrites lies directly below it in the coal field, of about six inches in thickness.

The two next coals in the table from the Wolverhampton coal field, show a similar result. The sixth and seventh, or the last two coals of table No. 1, belong to North Staffordshire—the district of the "Potteries." There my results are also given from a direct personal observation of several years; and I do not think I err in saying, that the materials of this district, taking

coal and ironstone together, are the worst in the kingdom for iron smelting. The coals given are compared under precisely similar conditions both with cold and hot blast, and although obtained from the working of a very small furnace, (only 32 feet high,) the *comparative* results will not be affected thereby. They lie very close to each other, being merely separated by a stratum of shale a few feet in thickness, often less, and, consequently, show how great a difference occurs, not only in different districts, but within a few yards, vertically, of the same field.

With modifications of the shape, and increase of size, (to which we shall attend more particularly under that head,) we were ultimately able to work No. 6, ash coal, in the furnace, without coking, and at a consumption of only $2\frac{1}{2}$ tons to the ton of iron, with a make of upwards of 70 tons a week; but No. 7, rider coal, although these conditions altered the make considerably, and the yield slightly, we were never able to work *without* coking; again and again we tried to do so by commencing with a small quantity, and gradually increasing it, but in vain; every increase of this coal to the burden, without coking, was followed by a decrease of yield, make, and quality.

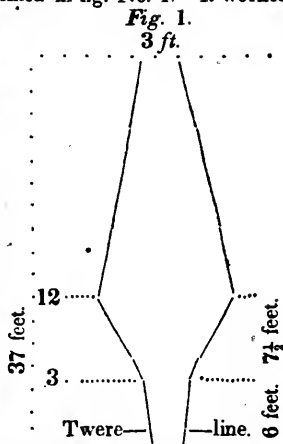
As regards ironstone, the effects of different qualities are not so striking as those of coal, with respect to *yield*, but they have a great influence on the *quality* of the iron produced. For instance, that which is known as the Shropshire pennystone—a peculiar kind of argillaceous ironstone found in small nodules imbedded in a stratum of indurated clay—and containing about 30 to 35 per cent. of iron, is supposed to give the peculiar strength and toughness to the Shropshire pig iron. When another ironstone, (siliceous) locally termed “crawstone,” which is found partially stratified in a bed of sandstone rock, is mixed with the pennystone, even in proportion of 1 to 10, the effect is very observable in making the iron much more fluid, altho’ it retains its stoutness. Again the effect of the “red ore” of Cumberland, or peroxide of iron, mixed with argillaceous, or other ironstone, is well known; it adds in every case very materially to the strength of the iron, and the effect is especially so with the hot blast. Forge cinder, which is a protoxide of iron, mixed with silicious, or other foreign matter, has a directly contrary effect both with cold and hot blast,—so much so, indeed, that I have seen hot blast iron which had been made with a large proportion of “cinder,” so weak as to break into several pieces when dropped on the ground from the height of a couple of feet. I may here remark, that it is not surprising that we should hear so many conflicting opinions on the *strength* of hot blast pigs, by those who only quote results without considering the conditions which affect them.

These results on the quality of iron by the use of different kinds of ironstone are very general, but such effects are well known, and are constant; and when we consider that there is only one kind of iron, in fact, surely it is worthy the attention of the scientific to inquire whence arise such differences, and how they should be produced by a simple mixture of “red ore,” or of “forge cinder.”

2d, Influence of shape and size.—We now come to a few results connected with the shape of furnaces; and on this point there seems to be at different times a ruling fashion. At the time of making the experiment to which I shall first refer, which was before the hot blast had been brought into notice, the prevailing fashion in England was to make the furnaces as narrow as possible, both at the “neck,” or filling place, and at the “hearth.” The furnace on which the experiment was made was at Lightmoor, in Shrop-

shire, the shape and size of which is represented in fig. No. 1. It worked worse than any of the others with the same coal, which was a mixture of those already referred to in table I; and the only difference of its shape, compared with the others, is in being about 6 to 9 inches wider at the boshes, and three feet less in height.

This furnace consumed about 5 tons of coals in producing a ton of iron, and made only about 40 tons per week. The alteration made upon it was very simple to appearance, consisting only of widening the top from 3 feet, to 5 feet diameter, and carrying that width perpendicularly up 6 feet higher; also placing two filling holes, one on each side, over twere, instead of one in the middle, merely, as it were, placing a cylinder of $5\frac{1}{2}$ feet diameter and 6 feet high upon the top.



Simple as the alteration appears, however, it was followed by very extraordinary results; the moment the charge arrived at the bottom, the iron from hard forge, became fine No. 1. The burden was accordingly increased from time to time, until this furnace with the same material and same blast, made 60 tons per week of good forge pigs, with a consumption of only $3\frac{1}{2}$ tons of coal to a ton of iron. The result is not attributable to the widening and double filling holes alone; for the effect was repeatedly tried by filling holes at the original height directly under the upper ones, and in every case we had to take burden off to make an equal quality, thereby reducing both the quantity and the yield.

Mr. Gibbons, of Corbyns Hall furnaces, near Dudley, has arrived at very striking results with cold blast, by alteration of shape and increase of size. He states in his publication on the subject, that he was led to the idea by observing the well known fact, that furnaces, especially cold blast ones, scarcely ever come into full work until six months after they have been blown in; and also, that every year, so long as the "boshing" of the furnace is not wholly gone, they improve their work both in yield and in quantity; further, in observing that furnaces, when blown out, although they had not been working for more than six or eight months, were materially altered from their original shape. By studying the natural shape, as it might be termed, he has arrived at an improved form.

This improved furnace (fig. 2.) has more than double the capacity of his original one, the dimensions of which were 8 feet wide on the hearth, $3\frac{1}{2}$ feet at the boshes, 12 feet at the belly, and 4 feet at the top. The height from the hearth to the boshes 6 feet, from the boshes to the belly 8 feet, total height, 45 feet; and the larger content is in the upper half—the top is 8 feet diameter, and there are four filling holes. The greatest produce of his original furnace he states to have been 74 tons per week, while that of the improved one has reached 115 tons in one week. This is by cold blast, with a density of only 1 lb. 13 oz. per inch at the twere.

Mr. Gibbons' opinion, like that of many others, is, that with the hot blast the shape or the size has very little effect; but that this is not the case is now well known.

3d, Influence of Blast.—In cold blast working, some practical men hold that the density of the blast should not exceed 2 lbs. to the inch, while others work it as high as 3 lbs. to the inch, or even more. In re-smelting also in the cupola, many prefer the fanners, which give a much softer blast than the old method of the cylinder; while others, after having tried the fanners, have returned to the original and stronger blast of the cylinder. We cannot suppose that this is altogether fancy or prejudice; I have no doubt that the differences of the material subjected to the blast is the cause, in a great measure, of such opposite results.

At Lighthoor, the various requirements of blast to make the best yield, with the different coals, were striking; coal No. 1, (of table I.,) which is the best, required a considerably less dense blast than the inferior, No. 2, (coal yard.) Indeed, blast, either in volume or pressure, seemed to be of little consequence to the working of the clod coal, from $1\frac{1}{2}$ lbs. to $2\frac{1}{2}$ lbs. to the inch, the yield was not affected, the only difference being a slight increase of quantity. Nor did diffusing the blast by a number of tweres seem to make a material difference. It is a fact that with this coal, and a furnace of ordinary dimensions, 60 tons of iron have been made in a week by one blast pipe only, the muzzle only 3 inches diameter, or 9 circular inches of blast.

On the other hand, the inferior, or, as they are called there, the "sulphury" coals, required a highly compressed blast to bring them to their best yield—one under $2\frac{1}{2}$ lbs. to the inch gave very inferior results; compare this with Mr. Gibbons' result, his materials seem well adapted for cold blast working, and we find density of blast not a great object to them. 1 lb. 13 oz. only was his density at tweres, and this continued the same although he doubled the capacity of his furnace.

(To be continued.)

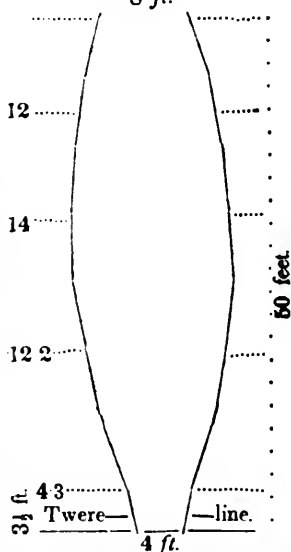
RAILROAD ITEMS.

Utica and Schenectady railroad.—The old board of Directors are re-elected. Erastus Corning, President.

Meeting of stockholders of Norwich and Worcester railroad.—The annual meeting of the stockholders of this road took place in this city yesterday. The meeting was large and the action upon the various subjects which came up harmonious. The treasurer's report shows a very decided and important improvement in the affairs of the company since the last annual meeting. The most important question acted upon was that of the extension of the road down the river to a point near the sound. By an almost perfectly unanimous vote, it was resolved thus to extend the road, and we presume the work will be commenced forthwith. The precise point to which the extension shall be made, is not yet fixed upon, the matter having been referred to a committee to examine and report hereafter.

Daniel Tyler was re-elected president.—*Norwich Courier.*

Fig. 2.
8 ft.



The following gentlemen were on Monday unanimously elected directors of the New Jersey railroad and transportation company for the ensuing year:—J. S. Darcy, Adam Lee, Stephen Whitney, John P. Jackson, John Acken, J. Phillips Phoenix, D. S. Gregory, Wm. S. Johnson, Abraham G. Thompson.—*N. Y. American.*

The United States steamer Union.—The Courier and Enquirer of June 3d says: "This new national steamer, on the plan of Lieut. Hunter, arrived in our harbor on Thursday, and, we are proud to say, has completely demonstrated the feasibility and superiority of this invention over all others. We were among those who doubted its success; and yet we feel assured that there is no individual in the country who more sincerely rejoices than we do in this practical triumph of Mr. Hunter in securing to his country and to the world a steam vessel which, at all times and under all circumstances, may be exposed to an enemy's fire without danger to her wheels. We are pleased to hear that Mr. Hunter is quite sanguine of very greatly increasing the speed of the next vessel to be built upon the same plan."

Charles L. Schlatter, Esq., Chief Engineer of the public works of Pennsylvania, has resigned, having received an appointment from the war department, which will station him at Chicago.

HARTFORD AND SPRINGFIELD RAILROAD.

This long talked of railroad, is, we have evidence to believe, soon to be completed. It *ought* to have been done at an earlier date. Its completion will make the *fourth* railroad from the waters of Long Island Sound, connecting with that great *main artery*—the Western railroad from Boston, which is to be like the *trunk* of a vast tree, with branches putting out in every direction, reaching into every northern and western State in the Union, yet like the branches of a tree all pointing to a common centre, which is Boston; and, like the tree whose sap descends in the autumn through the trunk to the roots, and ascends again on the return of mild breezes in the spring to the branches, so will flow a vast amount of business to and from that enterprising and calculating city, which has hitherto, and would always have come to New York, if her capitalists, her business men, and her *politicians* had possessed a tithe of the public spirit and far reaching sagacity which has characterized the course of the Bostonians. Boston has never, like New York, made herself ridiculous by opposing every, or any public work which in the remotest degree would add to her business, or increase her wealth and population; but on the contrary, her citizens have been always ready both individually and collectively, to encourage and aid those in other places who were willing to risk their capital in the construction of public works *pointing towards* Boston; having the sagacity to see that no work of the kind could be put into operation without benefiting their own city. But how has it been, nay, how is it even *now* with New York? Have her citizens, with their immense wealth, with nearly as many *houses* and *ships* and *steamboats*, as Boston has inhabitants, given even a listening ear to those who for many years have labored and struggled to open an easy, direct, and *always* available communication with the interior; and sustained the few who at an early day projected the two noblest avenues that

could be constructed from her busy streets *north and westward*, to connect with the canals, (or, as her once leading citizens denominated them "*Clin-ton's big ditches*,") and with the vast lakes of the west? Never. A few, only of her intelligent and wealthy citizens have ever given these important works the benefit of their counsels and the aid of their means, and even many of these became disheartened, after having made a noble effort deserving a better result, and gave up in disgust at the apathy, the folly, or the short-sightedness of their fellow citizens; hence it is, that with a population of nearly 350,000, she can only *boast!* of a *single* railroad, built by her citizens, and terminating in her streets, of the *astonishing* length of—not like Boston with a connection or web of railroads of *twelve hundred* miles, but of—*about twelve* miles!!!

'Tis true her citizens have aided in constructing a number of railroads besides the Harlem road; there is the Paterson road of 14 miles, the Schenectady and Saratoga road a little longer than either of the others named, and the Stonington road, and the Long Island road, making a total of about *one hundred and sixty* miles, and perhaps they have aided in the construction of others at a distance some of which have not been completed, and where there was no possibility of immediate benefit to this city when completed, unless the city is benefitted by the game of shuttle-cock, so much played in Wall street with railroad stocks by a class of gentlemen who apparently grow rich by the game rather than by the produce of the roads.

Had sound policy and good judgment directed the expenditure of the capital invested by our citizens in railroads of comparative insignificance, we should now have the benefit of two main lines of railroad north and west from this city, reaching the Canadas and the great lakes, which would eventually have their numerous branches penetrating almost every county in the State, and other States, through which New York merchants and cartmen and owners of real estate would derive a large portion of the benefits of an immense business which will now find an outlet at Boston, and to which her citizens are richly entitled by their sagacity and public spirit.

The city of New York has been playing shuttle-cock with *fancy* stocks and politics, while Boston has labored at the *oar* and the *anvil* until she has spread herself all over the country, or brought the distant country to her very doors by means of her iron ways.

LOW FARES ON RAILWAYS.

The directors of the Boston and Providence railroad, have passed a vote to reduce the price of fare on the road on the 17th, one-third from the usual rate. The present price of fare from Boston to providence, 41 miles, is \$1 50. Reduced one-third, it will be 81; or two and a half cents per mile. This rate per mile, may, we think, be safely assumed as the rate which will yield the largest revenue to railways in this country. If adopted on the railways from Troy to buffalo, it would reduce the price of a passage between the two cities to about \$7 50; which is indeed, the price now paid in the second class train, in which passengers are transported like cattle in long low boxes, with here and there an aperture to admit light and air, but no glass windows

to admit light and exclude air, when necessary. Should the several railway companies which control the railways from Schenectady to Buffalo, put these roads in first rate order, introduce the elegant and commodious cars used on the Schenectady and Troy, and on every other well managed railway, and reduce the fare in such cars or two and a half cents per mile; starting from every stopping place with the punctuality of a chronometer, * * * they would find their "account in it" at the end of the year. The travelling public would be far better accommodated than it ever has been between Buffalo and Schenectady, and the proprietors of the roads receive larger dividends than they have ever received. At any rate, it is worth while for them to try the experiment. * * * If railways are to be allowed a certain monopoly, they certainly ought to be compelled to accommodate travellers in the best manner, and at moderate prices.

"Truth is mighty, and will prevail," and so will the system of "low fares" prevail, as the recent course of the Boston and Providence railroad company (an account of which we find in the Troy Whig,) indicates. One dollar from Boston to Providence will be found a fair rate, and \$7.50 or \$8 from the Hudson to lake Erie, should insure good accommodations, good attention, and punctuality in departure and arrival. Railroads are designed as much for the accommodation and comfort of travellers, as for the benefit of capitalists and stockholders, and the increase of the former will be surely found to promote the interests of the latter.

RAILROADS IN ILLINOIS.

A correspondent of the Cincinnati Gazette, travelling in Illinois, describes the only railroad in operation thus:

"I arrived at Springfield from Jacksonville, by railroad, distance 36 miles. This road runs from Springfield to Meredosia, on the Illinois river; the whole distance is about 55 miles. They have a locomotive which leaves Springfield every other day, and Meredosia alternate days, Sundays excepted. They have a tolerable pleasant passenger car attached. The fare is \$3.50 the whole distance; the trip occupies the greater part of the day, stopping both ways at Jacksonville to dine. This is the only finished railroad in the whole State, and it is in a miserable condition—so much so that no calculation can be made as to the time the cars will arrive; they generally say, "about such a time, if no accident occurs." The day I travelled on it, they ran off the track by means of one of the iron bars being loose and inclining in towards the centre of the track; not much damage was done. In some places the iron is torn off the rails, and remains off, and they have frequently to stop and get out to hold the end of the rail down while they run over it. The road is now in the hands of a company who have leased it for two years, for which they pay the State \$10,000. Much prejudice exists against it. I could always read a paper or book while riding in a railroad car, but in this instance I had enough to do to keep my hat on. The people here, say this 55 miles of railroad has cost the State \$11,000,000—that being the amount expended on this kind of improvement, while all have been abandoned but this one short piece."

Well, if this apology of a railroad has cost the State eleven millions of dollars, the people have only themselves to blame for it. When the subject of internal improvements came up in 1832, and strenuous efforts were made by some of her citizens to obtain means to construct a railroad, or canal

from the lake, at Chicago to the navigable waters of the Illinois, and thus open an easy and cheap communication through the State and make it a great thoroughfare of business and travel, the selfishness of the people would not consent to such a measure unless there could be—as in another State we could name—a grand system laid out to pervade the whole State, that all might enjoy equal privileges. In short, every man, or at least every member of the legislature, desired to have a city or a village on his own farm, that he might become wealthy at once; and hence, a large number of routes were projected, laid out, commenced, large amounts of money expended and then abandoned; and now complaints without number are heard from the very persons who caused, or did not prevent, such wastefulness, such folly. Illinois should have followed the example of New York in her early days of internal improvement. She should have constructed her *great* work through the State that other people might pay her tribute for passing and then have rested. A State can no more waste her means with propriety on visionary schemes than an individual, nor can she be justified in undertaking to construct works of doubtful utility merely to quiet a set of selfish individuals that they may not oppose works of vast public benefit.

RAILROADS IN INDIANA.

By the following paragraph from the Indiana State Journal, we learn that the company organized to complete the railroad from, as we suppose, Indianapolis to Lafayette is making some progress. This road was originally designed, we believe, to connect Michigan city with Indianapolis, and to be continued southwardly to Madison on the Mississippi river. We have had very little information of late in relation to the railroads and canals of Indiana. Will some friend of those works and of the Journal furnish us with an account of their present condition.

The Railroad.—By a letter from the president of the company, we learn that the cars have commenced running to Scipio, and that that place was to be the depot from last Monday week. In about five weeks the cars will run some 7 or 8 miles further north. The company, although not a year organized, have expended rising \$50,000 on the road, and have nearly completed 17 miles; part of the grading of which, however, had been previously done by the State. We understand the company to be still going ahead, and in fine spirits.

The Troy Whig says the number of passengers carried over the Schenectady and Troy railroad during the week ending June 10th, was 1932; averaging 276 per day, Sunday inclusive.

HARTFORD AND NEW YORK.—The fare between Hartford and New York, by railroad, and also by the river, has been reduced to two dollars and fifty cents;—*fifty cents too high still.*

NEW RAILROAD PROJECT.—A correspondent of the Boston Daily Advertiser submits various statements to show the feasibility of building a railroad from Montreal, passing through Sherbrooke, L. C., Lancaster, the north of the White Mountains and Conway, to Great Falls N. H., connecting at the latter place with the railroads to Boston.

To the Stockholders, Directors and Officers of Railroads—to Civil Engineers, Inventors of Railroad Machinery, Dealers in Railroad Materials and Mathematical Instruments—and to the Editorial Corps generally—

The undersigned, proprietors of the American Railroad Journal, take this means of representing to those interested in the success of railroads and internal improvements generally, the advantages afforded by their work as an organ of communication with each other and the public, and also as an advertising medium—this being the only work devoted to the subject in the country—having been from its commencement favored by the communications of some of our most distinguished Civil Engineers and by the advertisements of several of the most successful manufacturers, inventors of improvements in railroad machinery, and dealers in railroad iron in all its forms.

Being desirous of bringing the work within the means of all who wish to avail themselves of its pages, they have obtained new type of smaller size, and thus are able to give three-fourths as much matter in *half* the number of pages, for two dollars a year; and as its circulation increases, we shall increase the quantity of reading, and *reduce* the price, hoping by this means to increase its usefulness, and give additional interest and value to the work. It is the only means by which advertisements in a single paper can reach those interested in railroads in widely distant parts of the Union, and it is designed to include *all* such persons among its subscribers.

TO DIRECTORS AND STOCKHOLDERS OF RAILROADS—

We need not say that the greatest ignorance has hitherto prevailed among people generally, in regard to the profit of railroads, and their character as an investment. It is true that, in many instances, where railroads have been constructed to benefit particular places or persons, without regard to other circumstances, the stock has not been found profitable, though even here in some cases, the value of property has been increased in amount equal to the entire cost of the road, but in almost every case, if not in *all*, where railroads have been *judiciously* located, *economically* constructed and *well managed*, they have proved good investments, and we do not hesitate to say that, within a few years, when those railroads now in course of construction, shall be completed, and others made to connect them with each other, and with canals and navigable waters, and further improvement of machinery now in rapid progress, shall be accomplished, railroad stocks will be found the safest, the most productive, and the favorite mode of investment. Even now, every mile of railroad completed, adds additional value to the thousands of miles already in use. Correct information only is required by the mass, in relation to the causes of failure, as well as to the true state of the case where works have been properly constructed, and are judiciously managed, to elevate the character of railroad stocks to the position they are designed to occupy. And how can such information be generally disseminated, you ask, to which we reply *circulate* the *Railroad Journal*

widely, and thus enable us to collect, digest, and arrange in tabular form the results of all the experience on the different roads in this country, and Europe, which will enable each company to adopt the improvements and avoid the errors of their neighbors, and to introduce economy and method in all their operations. As evidence of our desire to aid in the dissemination of correct and useful information, we propose to send to railroad companies and others interested, 25 copies of the Journal for one year, in one package, for \$30; and to advertise one square on the cover for \$8 a-year, and longer advertisements in proportion, thus giving the Journal and a yearly advertisement of a square for \$10 a-year. Will you not, then, aid us in extending its circulation? and thereby promote the *general cause*—*your own and our interest*? We shall see.

TO CIVIL ENGINEERS.

The profession of Civil Engineers not having been organized into a society or institute, in this country, has as yet no official organ of communication with each other, or with the public generally. Meanwhile, the pages of the Railroad Journal have generally been resorted to for this purpose, and for a period of several years a good proportion of the professional papers which have been published have appeared therein. The circumstances of the times having made the necessity for such an organ greater than ever, it is respectfully urged upon Civil Engineers generally, to favor this work with articles of information, or discussion, on some of the important topics upon which it is desirable to obtain an exchange of opinion. When cuts or diagrams are necessary to illustrate their subjects, if not too costly they will be procured at the expense of the proprietors. As one, among many reasons for favoring this work, we may mention that the important subject of the employment of professional labor upon many legitimate objects other than railroads and canals, can be successfully advocated only in this Journal. It only remains for Civil Engineers themselves to decide whether a vast field of usefulness and profit to themselves and to others be opened or not.

TO MANUFACTURERS OF LOCOMOTIVES, STEAM ENGINES, RAILROAD MACHINERY AND MATHEMATICAL INSTRUMENTS,

This work affords a ready means of announcing their improvements to railroad companies, and also of advertising. It is well known that the newspapers of the day are seldom resorted to for advertisements of this class, and some mode of supplying this deficiency should be obtained. It is the intention of the proprietors of this Journal to make it the proper vehicle for all such notices—and we may confidently say that through its agency the reputation of our locomotives in Europe was first made known.

It is respectfully requested that manufacturers will communicate to us for publication, the peculiarities of their works, with a list of such engines as they may have constructed—particularly marine engines, with the dimensions and name, etc., of the steamers.

The performances of new engines, frequently, do not receive the credit they really deserve, because they are vaguely, and often incorrectly repre-

sented in the public journals. If such performances are well attested and presented for the consideration of those interested, it will certainly afford the best recommendation of their value, and the notice of the press generally can easily be obtained by means of the extensive exchanges of this Journal

TO INVENTORS, PATENTEES AND DEALERS IN RAILROAD IRON AND MACHINERY,

We may hold out the same inducements. The want of success of many valuable improvements may be traced to the difficulty of obtaining access to persons interested and who are scattered over the whole United States. To all such, a ready communication with civil engineers and with railroad companies must prove highly useful.

TO THE GENTLEMEN OF THE PRESS.

We call upon the conductors of the Press throughout the country, who direct *public opinion*, that powerful machine, which only in this country, can carry forward important public improvements, to take a more active part in the collection and publication of local information in relation to works in their own vicinity, that we may be able to collate, condense and arrange the whole, and return it to them in convenient form for re-publication; and thus enable the people in every part of the country to know the extent, the character and the *benefits* of the system in the United States. And we respectfully ask them to copy more liberally from the Journal, and to call the attention of their readers to it, as a medium through which to obtain information in relation to the subject, and to send their paper in exchange.

GEORGE C. SCHAEFFER,
D. K. MINOR.

WOODEN PAVEMENTS.

We have always given our testimony in favor of this improvement. But it, like many other inventions, has had an undulating road to traverse in its ascent to permanent fame—at present it is on a descending grade, but gathering impetus to reach, by the aid of a good head of steam, and some stout pushing from it friends, a still higher level.

There are persons always ready to oppose everything, not of their own invention; but in spite of these, the improvement gained ground, until it was injured, as inventions sometimes are, as well as individuals—by their friends. This was done by the thousand and one patents which were taken out as soon as wood paving became somewhat the rage. We have from time to time noticed some of these; but a proper introduction to the whole, would be some dozen pages of solid geometry; and a suitable conclusion a dissertation on the misplaced ingenuity of inventors. How many of these blocks were ever cut, is beyond our comprehension. In fact, we do not believe that a tithe of them ever was made; or if made, it would require a professor of mathematics to put them down. The contest between these various patentees, each abusing every plan but his own, had a tendency to throw all into disrepute.

The next difficulty was the question as to the durability of wood in this situation. Here the interests of rival patentees again led to erroneous opin-

ions as to the value of wooden paving, and various unfair, and even untrue statements of the decay under the different proportions were widely circulated; as far as our own observation extends, we are satisfied that much of the blame attached to this system of paving, belongs to the imperfect manner in which the work has been done, rather than to anything peculiar to the material or its form.

Recently the whole system has been decried on the occasion of the taking up of a pavement of this description in the upper part of Broadway, in this city. This was precisely what we predicted at the time, and had the intention been to throw into disrepute wooden pavements in general, no more effectual means could have been taken than were adopted in the construction of this specimen. In the first place, the blocks were not made true to the figure required, and the wood was unprepared. Secondly, the blocks were merely *laid* in their places without being either wedged or driven together; and to crown the folly, the blocks were not lifted by hand, but in the following novel manner: a smart blow was struck upon the upper surface by the edge of a sharp hatchet, if this penetrated to a sufficient depth, the block was raised sticking to the hatchet, and if not, the blow was repeated. By these means a series of indentations was made on the surface, and cracks caused throughout the block, which operated no doubt greatly to the preservation of the wood. Through the interstices between the pieces thus *openly* disposed, the wash of rain storms and the filthy water of the gutters found a ready channel until filled up by a mass of decomposing matter, operating as so much ferment to set the whole mass rotting. We doubt whether any *fungous pit* on the large scale was ever more ingeniously contrived.

The first trial of wooden blocks ever made on this side the Atlantic, was an advance, if we are not mistaken, of any similar pavements in England. Although without any preparation but a superficial coating of pitch after the pavement was laid, these blocks, though somewhat uneven, are yet, after the expiration of *eight* years, less unpleasant to pass over than the oft repaired ordinary stone pavement in its vicinity. We have before mentioned that this is in one of the greatest thoroughfares in the city.

Had these blocks been properly *Earleized* before they were put down, we have no hesitation in asserting that they would have remained up to this moment in perfect order. *Kyanizing*, if ever useful, is certainly out of the question in this case, by reason of its costliness.

If any more attempts at laying this kind of woodway are to be made, and we are satisfied that they will be made, let all proper care be taken in securing a good foundation—let a figure of the blocks be mathematically correct, (and this can be more readily and economically done by a simple machine contrived for the purpose, than by a single circular saw,) let them be *Earleized*, and lastly, let them be closely wedged together so that no interstices can be seen, then a coating of hot pitch poured over the whole and sprinkled with sand; and a pavement will be produced superior to any ever laid—nearly, if not quite as durable as ordinary stone paving, which requires frequent re-

pairs—as pliant and smooth as the finest turf, and we doubt not in the end as cheap as any other.

ACCOUNT OF THE SOUTH CAROLINA RAILROAD.

We extract from the last semi-annual report of this company, the following interesting account of their road. The history of this work contains a page from the history of the locomotive in the United States, or in fact in the world. It will be seen that the first engine built for this company, was constructed by Mr. E. L. Miller, now of this State. Mr. Miller was, at that time, a director, and on his return from a visit to England, where he had seen the best locomotives then built, he was so fully impressed with the vast capabilities of the locomotive engine that he urged the construction of one, and without any one to favor his views at first, he soon made converts to his side of the question. Mr. M. even had a small working model constructed at his own expense, in order to convince the citizens of Charleston that this was the best form of motive power for their road.

We are informed by this gentleman that this was not the first locomotive *built* in this country, but the first which ever was able to perform.

AN ACCOUNT OF THE ROAD.

In the fall term of 1827, Maj. Alexander Black on his own responsibility, at the suggestion of a friend, obtained the charter of the South Carolina canal and railroad company, and in doing this was permitted to address the senate to get the bill through that body, there being no one in the senate sufficiently acquainted with the subject, (he being a member of the house.)

This Charter was materially altered and amended at the extra session of January, 1828, making the capital \$700,000, and to secure this Charter 3,500 shares of \$100 each was required to be subscribed at the first opening of the books, (6 weeks after the passage of the act,) namely, on the 17th March, and to remain open until the 21st of the same month. On the 21st of March, 1828, at 9, P. M., the whole amount was made up, and ten dollars on each share paid, amounting to \$35,000. all in Charleston, not a share taken at Hamburg, Columbia or Camden, where books were also opened.

This amount of capital was all paid,	\$350,000
And the books were again opened for	250,000
And again in 1833, for	300,000
And again in 1835, for	300,000
And finally in 1837, for	800,000

In all 2,000,000

And at each opening there was an over subscription by the original subscribers and their assignees, after the first subscription the books were never again opened to the public.

In the progress of the work, application was made to the legislature for \$250,000, only \$100,000 was granted, but this on liberal terms, 7 years, and interest at 5 per cent., payable at maturity of bonds. This has since been extended ten years more, to 1847, when the amount and interest will be due. The charter required that the road should be commenced within two years after the first subscription to the stock, and be completed for transportation within six years of that time. 1,000 tons of iron were imported immediately, and little more was done except making inquiry on the subject, and surveys on the line. Examinations of the country were made by Dr.

Howard, U. S. Engineer, and by Horatio Allen, Civil Engineer, who made the location; and on the 9th January, 1830, commenced the work at Line street, by driving piles of light wood, 8 by 8 inches square, $6\frac{1}{2}$ feet apart along the line, and 6 feet apart laterally, caps or ties morticed on the piles 6 by 9, 9 feet long, and rails same size, notched on to these ties and wedged on the inner side. This construction was continued through nearly the whole line. When the work was over 15 feet high, three piles abreast were driven, and a sill placed on them near the ground, which supported a framed work, (an inverted W) on which the ties and rails were secured as before described.

This work costing \$2,000 per mile including materials, except iron, on the level ground, and \$2,500 to \$4,000 per mile, over swamps 10 to 20 feet high. The excavation was done at 6 to 10 cents per yard generally.

In 1830, six miles only were finished; in 1831, nearly the whole road was put under contract; and in October, 1833, the road was connected from Line street to Hamburg, 136 miles.

The road cost for construction and materials, except iron,	\$584,542 43
Iron and spikes, and putting down,	125,309 47

\$709 851 92

Preliminary expenses and surveys,	\$13,894 68
Engineer department,	72,006 39
Work shops and materials, negroes, etc.,	43,892 11
Machinery, engines, cars and inclined plane,	76,523 89
Land \$13,950 82, road police \$18,159 89,	32,109 71
Office expenses to 1st Nov. 1829,	2,869 69

241,296 47

\$951,148 39

This road thus constructed with some alterations and improvements was kept up on *stilts* till 1836. Requiring then heavy repairs, and to be almost rebuilt, which was commenced that year by importing heavy flanged iron, now on the road, throwing up an embankment to support the piles and rails, and replacing timber where it was decayed.

This was continued through the years 1837, 1838, and completed in 1839 increasing the cost of the road and property of the company, in lands, buildings, negroes, machinery, materials, etc., as represented in the accounts, semi-annually reported by the secretary and treasurer, to \$2,506,762 61, nearly \$400,000 of this amount having been paid for from the income, rather than increase the capital to the cost of the road.

The grades on this road are very easy, not exceeding thirty feet in a mile, on the 120 miles to the inclined plane. That descends about 180 feet in half a mile, and beyond the plane a fall of 70 feet in two miles, or 35 feet per mile.

This inclined plane has been regarded a great mistake in the location of the road, as it might have been avoided by increasing the length of the road about six miles; but this would have made a continuous grade of thirty feet in a mile, where the trains would have been much retarded by frost, or when slightly wet, which is nearly bad as frost; and the cost of keeping up six miles of road on side hills, and having many curves, would have been more than the average of other parts of the road, and at the present reduced rates would probably exceed six hundred dollars per mile, or \$3,600 for the six miles per year, which is very little less than the expense of the inclined plane; and passengers are passed over the latter with less delay than, (and without the expense,) on the six miles of road. The locomotive engine hav-

ing been substituted for the stationary, the expense is reduced about three thousand dollars per year, and is capable of performing more than has ever been required in a day, and almost daily making a trip to Hamburg, (16 miles,) besides doing the work of the plane. So the plane is not so objectionable as it was believed to be.

I would not be understood as recommending a steep inclined plane, requiring stationary or other extra power to overcome it, where it could be avoided at the maximum grade on other parts of the road. But having this plane, I would not recommend the abandonment of it at present, nor at any future time, unless a great increase of profitable business should render it more inconvenient than it now is, and warrant the cost of cutting round it.

HISTORY OF THE LOCOMOTIVE ENGINES.

Extract of a report by the Honorable Thomas Bennett, to the board, January 14th, 1830—five days after the building of the road was commenced.

"The locomotive shall alone be used. The perfection of this power in its application to railroads is fast maturing, and will certainly reach, within the period of constructing our road, a degree of excellence which will render the application of animal power, a gross abuse of the gifts of genius and science."

This was assuming a great deal, when animal power was used years after this, on all the other railroads then constructing in this country. But what then were our expectations as regarded the performance of a locomotive?—On the 1st of March, 1830, a committee reported that they had accepted the offer of Mr. E. L. Miller, to construct a locomotive engine in New York, at the West Point Foundry; and that she should perform at the rate of ten miles an hour, instead of eight as first proposed, and carry three times her weight, which was required the year before on the Liverpool and Manchester road, at the trial of engines for the premium of £500, which Mr. Miller went out to witness. Mr. Miller's engine, under the above contract, was brought out by him in the fall of that year, (1830) and on the 14th and 15th of December, had her trial, and proved her power and efficiency double that contracted for—running at the rate of 16 to 21 miles an hour, with 40 to 50 passengers in some four or five cars, and without the cars, 30 to 35 miles an hour.

This engine continued to carry passengers up and down the line until the road was finished; at one time going 72 miles out and back the same day—and carrying at one time 100 passengers. After the road was completed, this engine conveyed the passengers between Aiken and Hamburg for years, and probably ran as many miles as any engine ever built, and performed equal to any of her size, (about four tons weight.)

This was the first locomotive engine, we believe, built in the U. States, to run on a railroad—she was at first called the "Best Friend," but having her boiler burst in June, 1831, and renewed in Charleston—she was afterwards called the "Phoenix."

From 1836 to 1843, 4 engines only were ordered; 2 in 1837, and 2 in 1839; all from Philadelphia. 7 others were received in 1837 and 1838, of the 35 ordered above.

In the last two years, four engines have been built in the work-shops of the company, besides rebuilding several of those previously purchased.

The whole number, in the list annexed, (marked 8) is 44, purchased and built by the company, and are accounted for as follows:

19 broken up, (except 2 boilers rebuilt.)

1 sold to the St. Joseph's railroad company, and 24 in the present schedule.

Of these, 6 were made in Philadelphia, 10 in Charleston, and 7 in Eng-

land—including 1 of the Philadelphia, 2 of the English, and 2 of the Charleston, rebuilding, or to be rebuilt.

Preparations are making for two more engines like the Orangeburg, the first of our make; which performs so well—parts are cast and fitting, and will no doubt be finished for another season's business.

It will be seen by the foregoing statement, that four engines only have been ordered in the last six years, and none in the last three years. Yet the power has been kept up by building and rebuilding much more efficiently, than when six or seven were ordered annually.

THE PECULIARITIES OF THIS ROAD, ETC.

The construction of this road on piles is becoming more in favor with others, as well as those having the advantage of it. Several roads at the north are partially on this plan. The New York and Erie railroad to be 446 miles long, is to be about one-half, built in this way. Over 70 miles of piles have been already driven.

It saves much of the cost of embanking a road by being able to transport the earth upon it to fill the valleys and swamps, and before it is necessary to do this, the income of the road is providing for the payment while it is constructing.

It preserves the line and level of the road after the embankment is made; when roads are built on fills and cuts without piles, the superstructure is continually liable to be disturbed by the sinking of the banks, or water settling in the excavations, much to the injury of passing trains, frequently breaking axles, and otherwise deranging the machinery of the engines.

The large wooden water-courses through the road are much more safe, and give less trouble than those made of brick or stone, unless very large, and foundations well secured, which has been difficult to attain in some of the late constructed works. The cost of the wooden-culvert is less than the interest of the cost of those built in masonry, and they can be kept in repair for one-fifth their first cost annually.

The flanged iron, now on the whole of the main track, weighing about forty tons to the mile, gives no trouble; a less number of bars have failed since first commenced putting it down in 1836 than have been condemned in the first year of the best edge-rail on other roads, although the latter are decidedly preferable where timber for rails cannot be readily and cheaply obtained.

The frequent turn-outs every four or five miles, answer nearly all the purpose of a double track, while the first cost and expense of repairs of a second is saved.

The lateral sections for supplying wood to the tenders, keeps it off from the road, lessening the risk of fire and gives despatch in receiving it.

The contracting for the wood cut and hauled in lengths to feed the engine, avoids much trash that would be caused by the chips and bark that would be collected if cut at the station.

And by having the wood corded or piled for measurement by the station man, he is made responsible for the quantity and quality in each cord.

The barrel cars, found only on this road, contribute largely to the economy of transportation; these, both for passengers or freight, cost about half the expense of the square car of the same capacity, are much more durable, and require less repairs, and if thrown from the road are not so liable to be broken.

This was lately tested, by the rolling off of one down a hill, several rods, loaded with cotton, without starting a joint. In putting it on the road, however, by the carelessness of the workmen who did it, several staves were

broken; advantage was taken of this by proving how readily and cheaply it could be repaired. The broken staves were replaced with new ones at a trifling expense. When a similar accident happens to the old formed cars they are generally so much broken as to be unworthy of repair.

The new arrangement of the interior of one of the barrel cars looks awkward, and is frequently condemned by strangers at first sight, and some are resolved not to be reconciled to it. The warm weather will show the advantage of this plan when the windows are required to be open—the passenger is kept more out of the dust, fire and sun, than by any other arrangement of the seats. The cushions are more easily kept clean, and being in the centre, are warmer in the winter and cooler in the summer. The seats, back to back, give more room under them for small baggage, and the rails and shelf over the backs are for light articles, such as too frequently occupy half the seats in the other cars.

VISIT TO MR. BURDEN'S IRON WORKS, TROY.

We find the annexed account of a visit to the Iron Works of Mr. H. Burden, near Troy, in the New York American, of 24th May—from the pen of its able and observing editor, Mr. Charles King. A recent visit by one of the editors of this Journal enables us to add a few additional particulars to his vivid account, which may possibly aid in a clear understanding of this establishment.

The fall of water, within 35 rods, is about 53 feet, which enabled the ingenious proprietor to exercise his mechanical skill to some purpose. His supply of water, on the ordinary sized wheel, would not carry the half of his present machinery—which, by the bye, is but a small portion of his ultimate aim—and, therefore he has constructed a wheel of 51 feet diameter, with 21 feet length, and 8 feet depth of bucket; in which 70 to 80 tons of water may be contained without overflowing—thus giving him the control of power in reserve, very far beyond, perhaps *double* his requirements, when all his present machinery, employing over 250 persons, all told, is in full operation.

This wheel is indeed a curiosity. Its equal has not, that we can learn, yet been constructed. With the exception of the buckets, it is entirely of iron. The shaft is of wrought iron, and in two parts, being about 16 inches diameter at the journal ends, and 10 inches where it comes together, within a collar, at the centre. Upon this shaft are four cast iron rims of about 4 feet diameter, with flanges so constructed as to receive the *arms* of the wheel which are wrought iron rods, $1\frac{1}{4}$ inch diameter, 23 feet long, and about 500 in number, passing through the flanges on the shaft, and made fast by two nuts. To the outer ends of these rods the periphery, or bed of the buckets, of 6 inch pine timber is made fast with nuts, by which this immense mass of material can be adjusted to an accuracy of movement truly astonishing, and it is so perfectly balanced that it is scarcely heard; and so tight and well preserved that the inside of the wheel is kept dry, not a drop of water nor a wet spot could be seen on the inner surface.

The pit for this immense wheel is excavated from a slate rock to the depth of 25 feet, and from the deepest part of it a tunnel is excavated through the

same rock into the natural bed of the stream below, for the discharge of the water. The average revolution of the wheel is about $1\frac{1}{4}$ per minute, or 105 revolutions per hour. There is a rack on each end of the buckets working into pinions 22 inches diameter, on different lines of shafting hundreds of feet in length, one of which operates a large number of nail machines, another a long line of spike machines and the famous horseshoe machines, and a third moves the immense balance wheel of 20 tons, and the ponderous machinery for making iron from the pig into all sorts and sizes; and blows the bellows for the puddling and other furnaces.

There are three great curiosities in this establishment even to those who are familiar with the process of making iron into its various forms, and then into nails and spikes—the wheel, the “iron whirligig” and the horseshoe machine. The like are not to be found elsewhere in this country.

Mr. Burden estimates that his wheel is competent to drive machinery sufficient to employ over a *thousand* persons, men and boys, as they are usually employed in similar establishments, though he has not now over one-fourth that number employed, but we hope eventually to see it tasked to its utmost ability, and that the ingenious and enterprising proprietor may reap a rich reward for his years of persevering industry.

“Taking advantage of a flying trip,” says the editor of the N. Y. American, “to Troy and of the civil invitation of Mr. Burden to visit his works, we spent an hour or two most agreeably among fire balls, fire bars and fire serpents of iron—all manipulated by men, and by machinery, like so many pretty and innocent play things.

“The works are situated in a wild ravine, worn out of a slate rock by a short and rapid natural stream called Wynant’s kill, we think Mr. Burden said. This stream supplies the whole power of the machinery here employed, and the wheel which imparts motion to the machines of the respective work shops is in itself one of the grandest objects of the sort we ever saw.

“It is an immense wheel of 51 feet in diameter, as high as a three story house, and 22 feet wide, over which, into troughs hollowed out for its reception, falls a sheet of water so thin that but for the evidence of the senses, one would hardly believe an agent so comparatively feeble, could cause the ponderous wheel to turn with a momentum, that puts in play hundreds of other wheels and machines of different sorts.

“The channel way in which this immense water wheel turns, is cut out of the solid rock. The axle is of wrought iron, and from the flanges project hundreds of iron rods, that support the periphery of the wheel, and steady and strengthen the whole structure. In its grand, deliberate and majestic revolution, there is really much of the sublime; and when it is perceived, that from this single and simple power, vast combinations of machinery derive their motion, the feeling of admiration is yet farther excited.

“The destruction of confidence, the absence of a national currency, and the other effects of misgovernment which have cursed the whole country, ever since the political malignity of Secretary Woodbury, aided by the political popularity and the unscrupulous will of Andrew Jackson, commenced a war upon the national currency—have of course been felt in these extensive works, and but few persons, comparatively, and portions only of the shops, were employed. Nevertheless, the various processes of puddling the iron,

of placing the misshapen glowing mass in a sort of iron whirlingig, (a recent invention, by the bye, of Mr. Burden, the patent for which, for England, he has sold at a round sum,) which, by its rapid evolution, casts off all the *scoria* while, by pressure, it forms the mass into a square block, of drawing this block over and under successive rollers into long, flat iron bars; the rolling out, by like means, of the flexible, red hot iron rods, that coil their bright folds alarmingly around the spectator, like so many living and literally, as now and then they come in contact with water, hissing serpents; this, and much more, we witnessed with great satisfaction, though not without a certain sense of bewilderment at the astonishing regularity with which everything proceeded amid a din and what seemed confusion unspeakable. A son of Mr. Burden, an intelligent young man, and a thorough workie, like his father, is superintendent of this department.

"Thence we proceeded to other shops. In the first was a row of lads sitting before sharp biting machines, within whose maw they continually thrust thin blades of cold iron, and which these reasoning and calculating machines convert as rapidly as thought, into nails pointed, headed and squared, ready for use.

"In another, a spike shop, this process was repeated on a larger scale; for there, thick square rods of red-hot iron were thrust into the machines, which by one simultaneous action, cut them off in the requisite length for spikes, headed and pointed them, and dropped them out below.

"No other human agency is requisite to either of these machines than simply to furnish the raw iron, and remove the finished fabric; the intelligent mechanism does all the rest.

"The most curious of all, however, is the more recent invention of Mr. Burden for making horse shoes. Two machines are required for this work, and a boy to assist the process. In the first, the iron in thin bars is put in, grooved and pierced with holes for the nails; in the next, it is flattened by pressure, and then rounded to the precise form of the hoop. Shoes of all sizes are thus made, and with unerring accuracy. Moreover, as the nail-holes are all punched upon an accurate calculation of the average thickness of the horny part of the hoof in which the nails are driven, there can be no possibility, even with a drunken or ignorant blacksmith, of pricking the horse, because the nail can only take the direction indicated by the hole. This is, in itself, a decided superiority in these shoes; for every one who has kept horses, knows how liable the noble animal is to suffering and lameness, from the holes of the shoe, punched by an unskillful blacksmith, being too far within the rim, and consequently conducting the nail into, or close upon the quick, instead of into the horn.

"Another advantage is in the great toughness of the iron thus fashioned by machinery; for none but the toughest would bear the strain.

"The price at which Mr. Burden can sell these shoes is greatly below that at present paid, and we hope soon to see them in general use.

"From these lower regions of Mr. Burden's dominions, we ascended to the upper air of his fine residence, on the hill, surrounded with beautiful trees and shrubbery, superb gardens, and commanding a view up and down and across the Hudson, of great beauty.

"Here, after the day's work, Mr. Burden is as retired from his factories, though lying directly beneath him, as if miles away; and we confess the satisfaction with which we witnessed the taste and comfort that surrounded the dwelling of this self-made mechanic.

MILK AND RAILROADS.

A queer juxtaposition—but no fiction for all that. The time was when some wag proposed the introduction of milk into our large cities by means of an open canal, but the age of canals has in a measure passed away. The next suggestion was, that of a covered aqueduct and the final distribution by pipes. This was too costly a plan and the pipes would have interfered with those for the distribution of Croton water in New York at least. But this is the "iron age" of railroads, and they have successfully accomplished and daily perform the task of the introduction of pure and wholesome milk into our city.

We suppose that the character of suburban milk is pretty well known, at least in New York. Water is the chief ingredient—starch, magnesia, and similar substances are added to give what the painters call body. The milk from the cow, which enters in a small proportion into the compound, is perhaps not quite so bad as it is usually represented, though we must confess that the cows are fed on most villanous stuff, which would be rather out of place even in the hog trough. We remember some curious details of the milk trade related by a worthy clergyman of our acquaintance, who happened to fall in with a milkman while at the pump. The fellow being of a frank disposition, cheerfully communicated many interesting particulars of a "professional" character. Among others, he stated that unless a certain quantity of water were added, he could find no purchasers for his milk, as from its color and consistency he would be suspected of adding the refuse of the starch factories!

We put these things on record for the benefit of future antiquarians—they already belong to the history of the past. At this moment pure and wholesome milk is sold all over the city at four cents per quart—the price for the composition above named was six, undoubtedly owing to the cost of the materials. This wonderful revolution has been wrought through the agency of the New York and Erie railroad—and affords a fine example of the benefits of railroads. This may be thought by some a small matter, but it is far otherwise, for, sometime since, we were informed that, if the milk business were to continue as it had commenced, it would be found necessary and profitable to run for its accommodation a special train.

The following is the mode in which the transportation is performed, as related by a resident of Orange county, in the *Cultivator*:

"The cows are milked early in the morning at Goshen and its vicinity, the milk put into cans containing from 60 to 75 quarts, into which a tin tube filled with ice is inserted, and stirred until the animal heat is expelled from the milk. It is then sent by the railroad, and arrives, a distance of 80 miles at the milk depots (which are numerous in the city,) in four and a-half hours. The tube filled with ice is again inserted, and the milk thus kept cool and sweet until sold. It can be afforded to the public at four cents per quart, of which the farmer gets two cents per quart and is well satisfied, as it yields more than butter at twenty-five cents per pound."

Here we find that three parties are benefited. The farmer makes a pro-

fitable disposition of his milk—the railroad company receives a handsome freight and the public a pure and at the same time cheap article. Not only so, but this milk is sold in the city of Brooklyn, the very head quarters of the milk factories and with the whole of Long Island “the garden of New York” at its back.

After this, who can say that railways are not destined to add to the comforts and luxuries as well as to the necessities of life—or who can say that the city of New York has yet begun to realize the benefits it will derive from being, at *some* distant day, the centre of a web of “judiciously located and well constructed” railways.

CHEAP TRAVELLING.—Those splendid steamers, the Troy and Empire, now carry passengers from Troy to New York for 25 cents, and sometimes for 12½ cents. No one can find any fault with this price but the proprietors. So much for “chartered monopolies.”

We take the above paragraph from the Troy Whig, and regret that it had not been accompanied with a word of disapproval by the editor of that excellent paper. This competition, ruinous as it must be to the proprietors, is also injurious to the community. It leads people *from home*, because it is, the say, cheaper to go than to remain, and many into other expenses which they cannot afford. The prices for passage should be fixed at reasonable rates to those who must travel, but at the same time at rates which will compensate liberally those who invest their capital in such boats, and provide such accommodations and excellent officers as are found in the above named boats and in the boats of the Peoples' line on the Hudson. We refer, not invidiously to, but because we have known them personally for years and can say confidently that more competent and careful men cannot be found in the business, than in the commanders of the boats referred to.

WESTERN RAILROAD.—Receipts for one week, June 3d,	
1843,	\$12,008
1842,	9,972
Increase,	2,036
Total increase in May, \$10,105, being over 25 per cent.	

The result, in part, of the adoption of the system of “low fares.” One unacquainted with the operations of a *business* railroad, i. e. on which all kinds of *freighting* is done, will hardly believe the assertion that a drove of 1500 live hogs were carried over the Western railroad a few days ago, in 16 cars in one train, and 50 head of cattle were also to go in the same train. As many as 3000 hogs have been taken over that road, in one train, we were told, when at the Greenbush depot for a few minutes, a short time since, and at an expense of course little greater than their feed would have cost while travelling to Boston. Thus it is that *Boston* steps in between New York and the western business, and says “after us, gentlemen, you can *help yourselves* if you will;” may we ask when, *when will* the citizens of New York see and feel the necessity of helping themselves?

NATIONAL INSTITUTE.

At a late meeting of the institute, Capt. Geo. W. Hughes, of the topographical engineers, made the following remarks on the subject of the stone of which the great Plymouth breakwater is constructed, specimens of which have been presented to the institute by T. W. Fox, consul of the United States at Plymouth:

"In listening to the reading of the record of the proceedings of last meeting, one item especially arrested my attention, in relation to which I beg leave to offer a few observations. I refer to the letter of Mr. Fox, of Plymouth, in which, after expressing a deep interest in the success of the National Institute, he informs the corresponding secretary that he has shipped for our cabinet a large specimen of the stone used in the construction of the breakwater at Plymouth—one of those stupendous works, combining the useful with the grand, for which his government is so justly celebrated, and which may be said to mark the difference between the utilitarian structures of modern times and the gigantic but useless and unmeaning works of remote antiquity. The dimensions of the breakwater are as follows: Breadth at base, 410 feet; ditto at top, 95 feet; breadth of front sea-slope, 85 feet; ditto inner or land-slope, 110 feet; average breadth of fore-shore, 65 feet; breadth of outer sea-slope, 108 feet; length at the base, 1800 yards; ditto on the top, 1700 yards; average height 42 feet. It is nearly finished, and when completed will contain about 3,500,000 tons of stone, at a cost of nearly £1,500,000, including the accessory works.

"All the rock employed in the structure, with the exception of about 100,000 tons of *cut granite*, is a *limestone* (abounding in *madrepores*) from the Oreston quarries on the cutwater near Plymouth. The weight of a cube foot of this stone is 168 lbs. or $13\frac{1}{2}$ cube feet to the ton. When the late Mr. Rennie undertook this work he considered it as a matter for congratulation that so *enduring* a material as the Oreston limestone could be procured with so much facility; but subsequent experience has shown that that eminent engineer was in great error in reference to its durability in salt water, owing to the ravages to which it is exposed from the attacks of a small *shell-fish*, which perforates it in all directions, and gives to the stone a *honey-comb* appearance, not unlike that of wood bored by the carpenter bee or by the sea worm. This enemy of the limestone is called the *saxicava rugosa* of Lamarck, or *mytilus rugosa* of Linnæus. It belongs to the genera Lithophaga, section C, Termipeda, first order of the 11th class, conchifera, of Lamarck, who thus describes it: "*Lithopaga*, third genus; boring shells, without accessory pieces or sheaths, and more or less gaping at their anterior side; ligament of the valves external. *Saxicava*: shell bivalve, transverse, inequilateral, gaping anteriorly at the superior margin; hinge almost without teeth; ligament external. The *petricola pholadeformis* belongs to the same genera." The *saxicava* generally attach themselves to the blocks of stone between the bottom and the line of low water; but they are sometimes found above that level. They penetrate the stone to the depth of five or six inches, and when this portion becomes abraded by the action of the waves, they bore still deeper into the rock. By this process, this immense work is slowly but certainly crumbling to decay; and it is stated, on semi-official authority, 'that hundreds of tons are destroyed by it (the *saxicava*) in every year.' They adhere to the limestone in thousands, at first not longer than a pea, but, as they bury themselves in the rock, increase in size till they attain half an inch in diameter. It seems doubtful if they feed on the material of the rock, as they put out their feelers from the holes to catch such food as may be floating by.

"The quay works of the dock-yard at Devonport, built of Portland stone, has also suffered from the ravages of this animal.

"It is not to the loose stones alone that the *saxicava* adhere, for they likewise attach themselves to the native rock below the surface of the water; and it is said, 'that their operations have been so extensive as to deepen the water in some places several feet. I have, in walking along the beach of Plymouth sound, picked up stones which had been perforated and detached by the active agency of these persevering *conchifera*.'

"The *modus operandi* by which these animals bore into the solid rock has been the subject of much discussion. That it is not by eating or gnawing into it is rendered pretty certain by their soft bodies and fragile shells. Dr. Buckland supposed that the holes were produced by the action of an acid secreted by the animal; but to this theory it may be objected that no acid has been found in it, and that if there were it would be as likely to act on its own shell as on the limestone. To this latter objection it might be replied that, perhaps, the *vitæ principalis* would resist this action. Professor Sedgewick suggested that the animal probably effected its lodgment by the rapid agitation of water in small vortices. We know that rocks in running waters are frequently pierced by a similar agency.

"I have recently seen, in the cabinet of Mr. Bruff, of this city, a fragment of a limestone rock from the vicinity of Gibraltar perforated by the action of a shell-fish, the shells of which are contained in the cavities. But the *saxicava* must not be confounded with the *date fish*, so called from its resemblance to that fruit, found in the limestone mud of the Mediterranean, which becomes on exposure sufficiently indurated to form a good building material.

"It may be of some consequence, Mr. President, that these facts should be known, especially to the architect and engineer, and this must be my apology for trespassing so long on the time of the meeting. It would appear, from the statements, that the only materials which can be used with absolute safety in submarine structures are granite, greenstone, basalt, or some other stone which has been previously fused."

NEW METHOD OF SENDING PORK TO MARKET.

We find in the Troy Whig the following novel description of sending pork to market. It is certainly an improvement, in point of economy, and still it will be vastly improved upon when the New York, and Erie and other railroads shall be completed to the great pork region of our country. We shall then see *cars* constructed for that purpose and filled with the produce of the west *in bulk*, and brought to our market during the cold seasons, and thus not only save a vast expense in packages, but also give our citizens not only the benefit of *winter employment*, but also of constant new supplies, and of course regular prices, during the winter—advantages to our citizens which alone would be worth, in seven years the cost of a railroad from New York to Cincinnati.

"We saw yesterday at one of our docks a canal boat loaded with pork *in bulk*, shipped by W. Martin & Co., of Circleville, Ohio, by the Troy and Erie line. This pork is cut up in the following manner. After taking off the head and hams, the remainder of the hog is cut into four pieces, which are first washed with a solution of saltpetre, and then sprinkled with salt. With no other preparation than this, they are shipped in bulk from Circleville to New York, where they will be packed and re-salted in the usual manner.

The lot of pork to which we refer, contained 55 tons, and looked as well as any pork we ever saw. By this new method of cutting it up, a great saving is effected in the cost of transportation; the quality of the pork being preserved equally well as when barrelled. This shipment will doubtless be followed by others of a similar nature."

TROY AND SCHENECTADY RAILROAD.

We passed over this road a few days since, and found it uncommonly easy to ride upon. On leaving the *Troy House* after an excellent breakfast, we entered the car, which seems to have been constructed with a view to cleanliness and comfort, being sustained by the "atmospheric springs," and well ventilated. We were taken by horse power over the Hudson, to the depot, and in a few minutes were attached to a locomotive and under way, at a rapid rate, notwithstanding the ascent, after passing a short distance, was at the rate of 52 feet to the mile for several miles. The route from Troy to Schenectady, by the railroad is delightful; well cultivated fields, the canal with its numerous boats passing in each direction; the Hudson stretching far to the north; the Mohawk with its beautiful *Cohoes*, its winding among the hills and its aqueduct for the passage of the canal; and the far off green hills which are beheld constantly presenting new and beautiful views, will render this road from New York to the west a favorite route. It will at least come in for its share of the travel when it is better known. From the little opportunity we had to examine the work, we were led to believe that it is well built, well found and *well managed* and therefore *deserves* to be well patronized.

DIVIDENDS ON RAILROAD STOCKS.

"The Boston and Worcester railroad company have declared a dividend of 3 per cent. for the last six months."

We desire hereafter to give an account of all declared dividends upon railroad stocks in the United States, and therefore will thank the officers of the different railroad companies to furnish us with official statements whenever dividends are declared, that we may be able to show the present and prospective value of such investments, which we believe will be found among the most profitable and the safest in the country.

"Please exchange" with the Railroad Journal, and if you will do us the favor to say that "the number for July is received, and may be examined at our office;" and that "subscriptions will be received, and the money forwarded;" and if you will even go so far as to copy the list of contents, you will greatly oblige the Editors, and aid the cause.

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